Electrical Review

WITH WHICH IS CONSOLIDATED WESTERN ELECTRICIAN AND ELECTROCRAFT.

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Fig. 1.—General View in Asbury Methodist Church from Balcony, Showing Lighting Fixtures and Illumination Effect.

Lighting Installation for a Church Auditorium

Modern Lighting System Provided for Asbury Methodist Church in Rochester — Chiefly Indirect Lighting with Luminous Bowl and Urn Fixtures—Concealed Sources for Direct Lighting of Platform

By H. O. STEWART

Engineer, Industrial Department, Rochester Railway & Light Co., Rochester, N. Y.

ONE of the best general tests for a proper system of illumination in an auditorium is the feeling of restfulness and the absence of eye fatigue which one experiences after being in the auditorium for some time. Although ample illumination should be provided, the method by which it is distributed should not detract the attention of the audience from the program. Very conspicuous fixtures, brilliant light sources, too much or too little illumination, should not be tolerated. The best system is one in which the light is soft, well diffused and supplied from light sources that are in harmony with the decorations and architecture.

The auditorium of the Asbury Methodist Church, of Rochester, shown in the accompanying illustrations was somewhat more difficult to illuminate than the average, as the lighting fixtures had to be placed near to the direct line of vision. A system of indirect lighting was, therefore, the only kind adaptable.

The extreme dimensions of the auditorium are 96 ft. by 64 ft. Its average height is 30 ft. A considerable part of the seating capacity is under the

balcony, which extends around three of the four sides. A good light is required on the platform for the preacher, organist and choir. The decorations of the auditorium are ideal for indirect illumination. The ceiling and coves are a very delicate cream; the walls

Fig. 2—Wall Urns Serving as Lighting Units at Main Entrance to Auditorium Under Balcony—Ordinary Brackets Would Cause Glare.

are colored with blended tones of brown over a coat of cream; the woodwork is natural oak and the organ is finished in dull gold. The windows are dark stained glass.

Most of the illumination is supplied by five large luminous-bowl type indirect fixtures (see Fig. 1) suspended 8 ft. below the ceiling, each containing five 200-watt Mazda type C lamps and X-ray reflectors. The art glass bottom of each fixture is dimly lighted with three 40-watt Mazda B lamps. One of these bowls is hung from the top of the central dome as a semi-direct fixture. The cross-sectional diagram (Fig. 5) shows the location of this lighting unit, as well as some of the others.

As the ceiling under the balcony is too low for ceiling fixtures, wall type fixtures were selected. The wall urns shown in Figs. 2 and 4, are 8 ft. above the floor and each contains an X-ray reflector which throws most of the light from its 100-watt lamp at an angle of 45° away from the wall. This angle was chosen, as the bulk of the illumination is required at the seats rather than in the passageway.

The platform is illuminated by four 200-watt lamps and X-ray concentrating reflectors placed in a metal box over the slot in the ceiling (see Figs. 3 and 5). The lamps are 4 ft. above the ceiling. The box is partitioned into four compartments so that the light sources can not be seen by those sitting near the front and at the sides of the auditorium. These lighting units are tilted slightly so as to increase the illumination on the organ. Those parts of the box which are visible have been painted a dull black for the elimination of glare. These units are quite inconspicuous and serve to light the platform very well.

Fig. 3.—General View on Main Floor of Auditorium—Note Location of Four Light Boxes on Ceiling for Lighting Organ and Platform.

The control of the lighting units was designed to be sufficiently flexible, so that economy could be exercised in supplementing daylight with artificial illumination as needed. A small amount of general illumination is supplied by the central fixture in the dome.

Fig. 4.—General View of the Auditorium, Showing Both Ceiling and Wall Lighting Units.

The lighting units over the platform, the two front ceiling fixtures, alternate wall urns, the three remaining ceiling fixtures, the remaining wall urns—these are turned on in the order named as the requirements for additional illumination increase with the decrease in intensity of daylight.

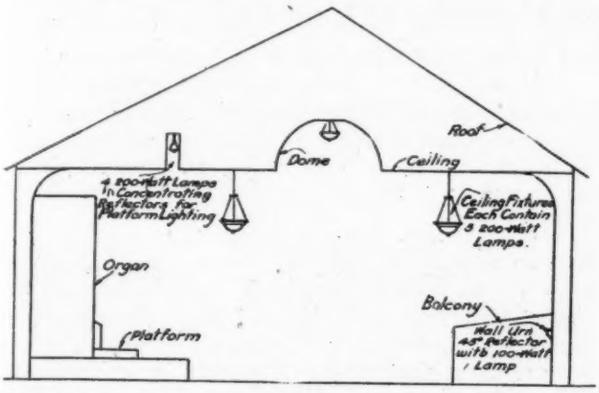


Fig. 5.—Cross Section of Asbury Methodist Church, Showing Location of Lighting Units.

Favorable comment on the new lighting of this church has been made by the congregation, by the trustees and minister, and by visitors. The illumination is very pleasing and yet efficient.

SUPPLEMENTAL STATEMENT ON ELECTRIC RAILWAYS GIVEN OUT.

Director Sam. L. Rogers, of the Bureau of Census, Department of Commerce, has issued the following supplemental statement in regard to capitalization and traffic of the electric railways in the United States. The original statement showing the growth of electric railways in this country during the past decade was published in our issue of May 31.

The total capitalization of the electric railways, street and interurban, for the year 1917 was $5,525,025,923, representing an increase of 46.4% over 1907; and deducting investments in securities and non-operating property, the net capitalization was $4,882,764,201, as compared with $4,243,317,727 in 1912 and $3,400,107,899 in 1907, representing an increase of 15.1% for the period 1912-1917 and of 24.8% for the period 1907-1912,

The total number of revenue passengers was 11,304,660, 462 in 1917, 9,545,554,667 in 1912, and 7,441,114,508 in 1907, representing an increase of 51.9% for the decade. The average number of revenue passengers per mile of track (based on total track mileage, including sidings) was 252,323 in 1917 and 216,522 in 1907; the average number per passenger-car mile, 5.4 in 1917 and 4.7 in 1907; and the average number per passenger-car hour, 53.7 in 1917 and 43.1 in 1907.

The detailed data are given in the following table:

ELECTRIC RAILWAY CAPITALIZATION AND TRAFFIC STATISTICS.

	1917.	1912.	1907.	Per cent of increase.[1] 1907-1917.	1912-1917.
TRAFFIC.					
Passengers carried	14,506,914,573	12,135,341,716	9,533,080,766	52.2	19.6
Revenue	11,304,660,462	9,545,554,667	7,441,114,508	51.9	18.4
Transfer	3,021,137,935	2,423,918,024	1,995,658,101	51.4	24.6
Free	181,116,176	165,869,025	96,308,157	88.1	9.2
Revenue passengers by divisions:					
New England	1,242,076,786	1,051,161,737	875,115,527	41.9	18.2
Middle Atlantic	4,225,287,044	3,513,720,591	2,839,019,161	48.8	20.2
East North Central	2,712,624,699	2,159,620,746	1,607,894,497	68.7	25.6
West North Central	902,368,927	787,301,146	615,630,852	46.6	14.6
South Atlantic	747,561,816	616,724,741	487,981,528	53.2	21.2
East South Central	292,004,689	268,785,533	220,887,485	32.2	8.6
West South Central	313,203,554	270,745,675	193,338,141	62.0	15.7
Mountain	162,222,128	154,224,248	113,304,063	43.2	5.2
Pacific	707,310,819	723,270,250	487,943,254	45.0	—2.2
Average number of revenue passengers—					
Per mile of track (all tracks)	252,323	232,556	216,552		
Per mile of running track	260,868	[2]	[2]		
Per passenger-car mile	5 41	5.06	4.70		
Per passenger-car hour	53.69	48.38	43.06		
Per mile of track (all tracks) by divisions:					
New England	223,468	198,536	179,546		
Middle Atlantic	400,322	349,867	321,520		
East North Central	214,346	183,142	155,789		
West North Central	246,184	254,081	245,432		
South Atlantic	228,064	208,193	212,699		
East South Central	201,355	208,947	207,466		
West South Central	186,162	196,730	229,831		
Mountain	127,877	153,104	188,404		
Pacific	150,824	172,790	160,951		
CAPITALIZATION.					
Capital stock	$2,473,846,651	$2,379,346,313	$2,097,708,856	17.9	4.0
Funded debt[2]	3,051,179,272	2,329,221,828	1,677,063,240	81.9	31.0
Total	5,525,025,923	4,708,568,141	3,774,772,096	46.4	17.3
Investments in securities and non-operating property	642,261,722	465,250,414	374,664,197	71.4	38.0
Net capitalization	4,882,764,201	4,243,317,727	3,400,107,899	43.6	15.1
New England	352,553,026	320,491,727	263,842,127	33.6	10.0
Middle Atlantic	1,696,403,938	1,312,329,549	1,194,940,494	42.0	29.3
East North Central	1,109,374,472	1,024,768,763	900,387,383	23.2	8.3
West North Central	341,884,368	300,821,223	251,673,038	35.8	13.7
South Atlantic	415,149,716	361,599,371	250,135,621	66.0	14.8
East South Central	141,410,566	118,166,868	99,599,823	42.0	19.7
West South Central	160,936,399	128,049,146	84,192,034	91.2	25.7
Mountain	88,125,354	75,630,871	45,920,878	91.9	16.5
Pacific	576,866,362	601,460,209	309,416,502	86.4	—4.1
Net capitalization per mile of track	111,233	104,930	100,495		
New England	64,474	61,577	54,724		
Middle Atlantic	167,942	134,702	140,724		
East North Central	88,163	87,102	87,292		
West North Central	94,848	97,807	102,948		
South Atlantic	130,144	125,409	112,013		
East South Central	97,518	92,051	93,925		
West South Central	95,695	93,272	100,083		
Mountain	71,987	77,514	76,358		
Pacific	125,596	145,428	102,272		

[1] A minus sign (—) denotes decrease. [2] Not including real-estate mortgages: 1917, $7,197,895; 1912, $6,097,245; and 1907, $4,059,805.

Interborough Rapid Transit Company's 70,000-Kw. Turbogenerator

Salient Features of Turbine—Methods of Operating Three Elements — Steam Consumption of Unit

THE Interborough Rapid Transit Co., New York, has recently placed in operation at its 74th Street Power House, a turbine that is remarkable for two reasons. In the first place, it is rated at 60,000-kw. capacity continuously, and 70,000 kw. for two hours, so it is, therefore, the most powerful prime mover in the world. Secondly, it has three elements, one high-pressure and two low-pressure, and it is the first triple cross-compound turbine to be placed in operation.

This immense machine will assist in meeting the greatly increased demand for transportation in New York City, due to the opening up of a new subway system, and the extension of the service of the existing subway, elevated and subway lines. The Interborough's power requirements have increased in the past few years with extraordinary rapidity. In 1904 the 74th Street Station contained nine reciprocating engines driving direct-current generators, each rated at 5000 kw. This amount of power sufficed for a while, and then in 1913, it became necessary to remove four of these engines and install in their place, three compound 30,000-kw. turbines. Though 90,000 kw. was thus substituted for 20,000 kw., this increase was hardly obtained when it, in turn became insufficient. Now, 70,000 kw. more is added, and probably additional units will again be needed in the not distant future.

The new unit occupies a floor space of 52 by 50 ft., and is about 19 ft. high. The high-pressure element receives steam at 205 lb. gauge pressure, and superheated 150° F., and exhausts it into the low-pressure elements at 15 lb. gauge pressure. The two low-pressure elements are identical in construction, and each receives one-half of the steam from the high-pressure element and exhausts it into the condenser where a 29-in. vacuum is maintained. All three elements operate at 1500 r.p.m., and each drives a generator rated at 20,000 kw. continuously, 23,500 kw. for two hours, and 30,000 kw. for a half hour. The generators deliver three-phase, 25-cycle, 11,000-volt alternating current.

Details of Turbines.

Though consisting of three separate elements, the entire machine is started, synchronized, and controlled

Fig. 1.—General View of Interior of Interborough Rapid Transit Power House, East 74th Street, New York, Showing One of the Westinghouse 30,000-Kw. Cross-Compound Units in Foreground, Newly Installed 70,000-Kw. Triple-Compound Unit in Center and Old 7500-Hp. Engine-Driven Units in Rear.

as a single unit. At the same time, any one or two of the elements can be shut down without interfering with the remainder, so that the high efficiency of a single large machine is combined with the flexibility of three smaller machines. In addition, the three small elements are mechanically much stronger than a single large one would be; the temperature differences in any cylinder are considerably less, and commercially common materials, with moderate blade speeds and stresses, can be used.

All of the turbines are of the pure reaction type, without the usual impulse elements, a form of construction considered preferable in view of the great volumes of steam to be handled. The high-pressure turbine is of the single-flow type, and is of cast steel. The low-pressure turbines are of the semi-double-flow type; that is, the steam enters near the center of the turbine and flows as a whole through a portion of the blading, and then divides into two portions, each of which flows through a separate section into the condenser. Since the low-pressure turbines must receive high-pressure steam in case the high-pressure turbine

Fig. 2.—Interior of Interborough Rapid Transit Co.'s Power House, Showing Old 7500-hp. Engine-Driven Unit in Foreground and Newly Installed 70,000-kw. Turbine in Rear.

is shut down, the central portions of these turbines are made of cast steel also. All three rotors are equipped with Kingsbury thrust bearings, in order to prevent axial movement.

Features of the Generators.

The generators are so connected to the busbars that any combination of them can be operated in parallel. In practice, however, all three are brought up to speed together, and synchronized through a single oil-switch connecting the generator buses to the main bus. Reactance coils are installed between the various buses, which limit the amount of current that can flow between the generators. Should a short circuit develop in any of the feeder circuits, or a burn-out occur within a generator, the generator affected is disconnected from the buses by a circuit-breaker without interfering with the operation of the other generators.

The method of synchronizing the generators is as follows:

The field current is first applied to all of the generators, and then the throttle valve of the high pressure turbine is partly opened. As soon as the high-pressure rotor starts revolving, it will start the rotors of the low-pressure turbines through the field current. All three then come up to speed together in correct phase with each other. They are then synchronized with the system and connected to it by closing a single circuit breaker.

Operating Features of Governor.

The governing mechanism must not only control the unit as a whole, but also each turbine operating

Fig. 3.—Close-Up View of 70,000-kw., Triple-Compound Turbine, Largest in the World.

separately. Some of the operations performed by the governors are as follows:

If serious electrical trouble develops on the circuit of one of the generators of the low pressure turbines, a circuit breaker will disconnect this generator from the bus bars. Relieved of load, the turbine begins to speed up, but before its speed has increased four per cent, its governor shuts off the steam supply from the high pressure turbine. This, of course, raises the back pressure of the high-pressure turbine, and a back-pressure valve opens allowing part of the exhaust from the high-pressure turbine to pass into the atmosphere, while the remainder goes into the other low-pressure turbine.

In the meantime, the first low-pressure turbine, being without steam, shuts down. When its speed reaches three per cent below normal, the governor admits high pressure steam, and the turbine continues

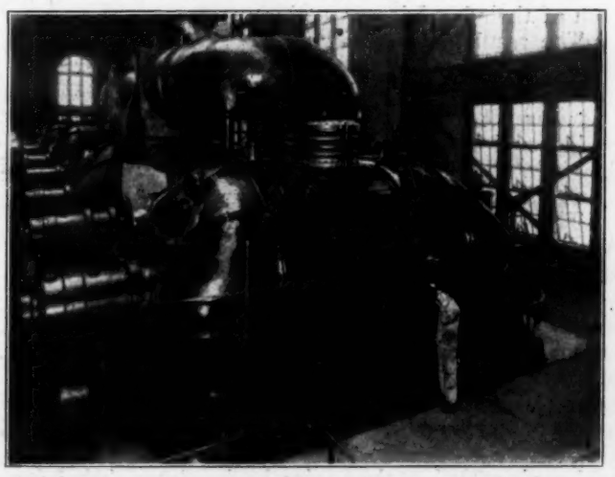


Fig. 4.—Governor and Controlling Mechanism for 70,000-kw. Turbine.

to operate at this speed until the switchboard operator either shuts it down or restores normal conditions.

Should the generator of the high-pressure turbine be cut out of the circuit, the governor cuts off practically all the steam to the entire system, leaving just a sufficient flow to maintain the speed of the high-pressure turbine now without load. The speed of the two low-pressure turbines decreases, and when the frequency drops three per cent, the governor admits high pressure steam direct to the low-pressure turbines, which then continue operating. The switchboard operator can now either restore matters to normal or shut down the high pressure turbine.

Each turbine also has an emergency stop, which will operate automatically in case the governor fails and the turbine begins to race, or it can be tripped by the switchboard operator.

When one of the turbines fails with the entire unit heavily loaded, the governors permit each of the remaining turbines to carry the maximum load of 30,000 kw. This can be maintained for a half hour, which is regarded as sufficient time to get other generators into operation, and thus relieve the overloaded turbine.

The condenser equipment consists of two 25,000 sq. ft. surface condensers for each low-pressure turbine. There are four circulating pumps, three Le Blanc air pumps, and four condensate pumps. All of these pumps are turbine driven (the air pumps directly and the others through gears), and all are so arranged that one or more can be put out of service without interfering with the operation of the condenser.

The steam consumption of the entire unit, which is a Westinghouse machine, at its point of best efficiency is 10.7 lb. per kw-hr. The high-pressure turbine and one low-pressure turbine, operating together, consume 12 lb. of steam per kw-hr.; and one low-pressure turbine alone consumes 14.25 lb. The total steam consumption at full load is 826,000 lb. per hour.

ELECTRIC STARTERS ADD TO SAFETY OF FLYING.

Description of Equipment Used on Trans-Atlantic Seaplanes.

It is not generally known that the "N. C." flying boats which accomplished the successful trans-Atlantic flight were the first heavier-than-air machines in this country to be equipped with electric self-starters for each of their big Liberty engine motors.

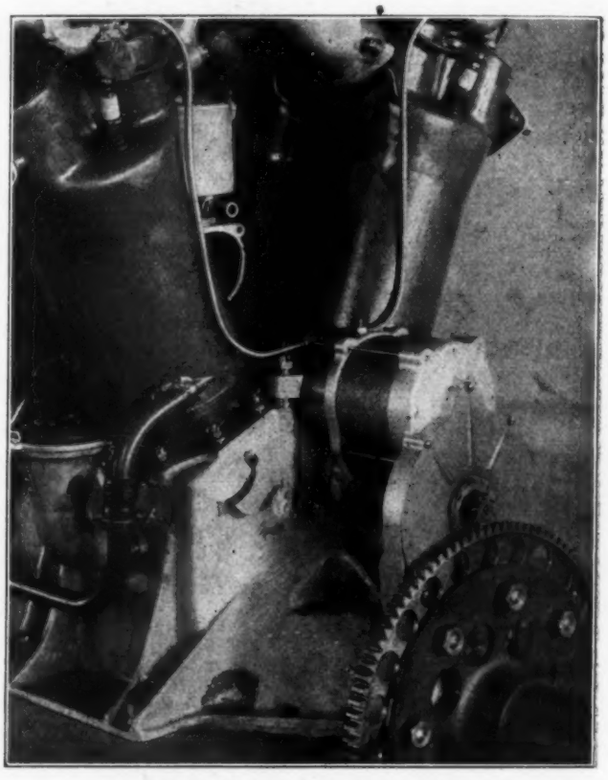
The result of the Navy Department's decision to so equip its seaplanes undoubtedly aided the success of the enterprise, for the NC-3, lost in the sea and fog near the Azores, all her engines stalled, wet and cold, would never have been able to taxi into Ponta del Gada under her own power without the assistance of mechanical means for starting her propellers.

This little device, the work of the Bijur Motor Appliance Co., of Hoboken, N. J., consists of a small 12-volt electric motor operated by a storage battery connected through a geared reduction to a Bijur automatic screw drive. On the end of the screw shaft is cut an 8-tooth pinion which meshes with a larger gear on the propeller shaft. The starter will turn over the engine at 40 to 50 r.p.m. with a consumption of 100 to 110 amperes and a maximum of 1300 ft-lb. is available on the engine crank shaft, for breaking loose a cold engine. When the engine begins firing the screw drive automatically demeshes from the crank shaft gearing. The storage battery weighs 26 lb. and has a rating of 24 ampere-hours, or sufficient to supply enough current to make 150 starts on one charging.

An interesting incident of the American trans-Atlantic flight was that all three planes carried extra propellers, intending if one should break, to descend to the water, change propellers, and start off again. They depended on the starter to make this possible.

It is also said that the C-5 (Blimp) met such strong head-winds on her trip from Montauk Point, Long Island, to New Foundland, that the force of the wind stopped her propellers, and it was necessary to ascend to a higher level to avoid them, the starter with which she was equipped starting the engines while in mid-air.

In the days before aeronautical starters were developed—which is to look back scarcely two years—it



Electric Starter on Airplane Engine.

took three men to start an airplane. One man turned over the propeller while two others, grasping him by his extended hand, stood ready to pull him away from the tremendous sucking power of the fast revolving blades.

A new aircraft engine starter, which fits on the non-driving end of the engine, has just been developed. It operates substantially the same as the propeller and starter (described above) except that the gearing is fully enclosed and the starter projects less than 5 in. from the crank case.

The starter is entirely disconnected from the engine except during the time of starting. The gears cannot be meshed while the engine is running and a safety device is provided which prevents damage in case of backfire.

Twin engine dirigibles of the "C" and "D" classes, U. S. Navy, have adopted the electric starting system. The equipment has also been in use for some time on Blimps, using Hispano-Luiza engines, and has more lately been applied to nacelles fitted with the "all-American" Union engine.

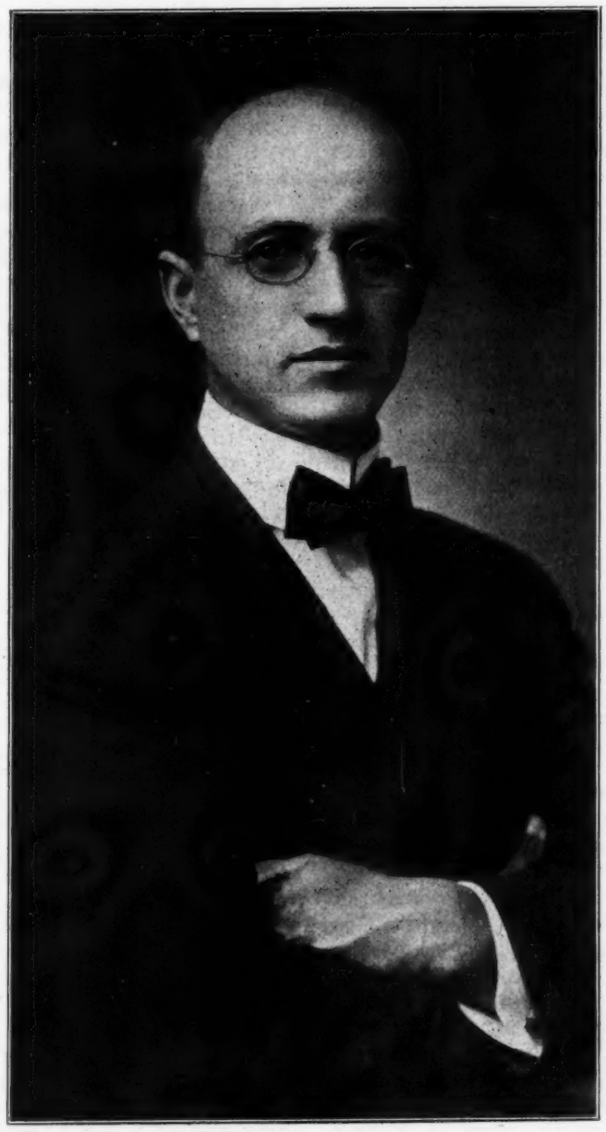
A. I. E. E. Convention at Lake Placid

President Adams' Address on Problems of the Day Makes Co-operation the Keynote — Technical Matters Receive their Due—Features of Convention

WITH a pleasing admixture of business, pleasure and relaxation, the thirty-fifth annual convention of the A. I. E. E. at Lake Placid, New York, came to a close on June 27. The program called for technical or business sessions during the mornings only, the afternoons and evenings being devoted to sports and pleasures and the relaxations that made the convention a real vacation. The program was a light one, as convention programs go, although the subjects might all be called heavy ones, serious problems of today and of tomorrow.

All the technical papers discussed problems of transmission—relay protection, the effects and benefits of grounding the neutral, effect of transient voltages, high-tension single-conductor cables for polyphase systems, dielectric field in an electric power cable, and problems of 222-kv. transmission—an arrangement that was thought to be more productive of results than a more widely diversified program. One of the outstanding features of the convention undoubtedly was the address by President Adams, excerpts of which follow and which will be found commented upon editorially on other pages.

In this issue will be found a report of the discussion on the two papers entitled "Transmission Line Relay Protection" and "Grounding the Neutral of Generating and Transmission Systems." The former of these papers appears on page 13 of this issue. The latter will be abstracted in the issue of July 12; in this same issue will be found an abstract of Mr. Silver's paper on "Problems of 220-Kv. Power Transmission," with the report of the discussions on the remaining papers and the important report of the Committee on Development.



President Comfort A. Adams.

In the opening address of the convention President Comfort A. Adams drew attention to the general unrest in all sections of the world arising out of the great war. This has led to a change in the old order of affairs. Speaking of the future he said: "Are we as engineers, educated men, who pride ourselves on our breadth of vision, who complain because we are not properly recognized in large questions affecting the public welfare, going to crawl back into our little cabins and leave the steering of the ship to those we consider incompetent, or are we going to scrutinize the ship's log to see why she ran on the rocks and then revise the sailing orders accordingly?"

With this simile Prof. Adams took up the subject of co-operation. He pointed out that the history of human society is the history of co-operation, that every commercial transaction is made on the assumption of mutual benefit to both parties concerned. "The more the mutual confidence and the co-operative spirit, the freer and the more efficient will be the interchange and the greater the mutual profit. This is merely the simplest possible illustration of co-operation to show its fundamental nature," said Professor Adams. "Industrial co-operation, from which my illustrations are drawn and with which engineers are mostly concerned, usually involves more than this simple and somewhat restricted co-operation between buyer and seller; it involves co-operation all along the line, internal and external, between producers, between consumers, and between producers and consumers.

"The obstacles to co-operation, particularly between the larger units, are of two varieties, material and human or intellectual. The chief material obstacles are space coupled with imperfect means of communi-

cation and transportation, differences in language, differences in coinage, weights and measures, and duties or tariffs. Some of these bear obviously only on international co-operation. The chief intellectual obstacles are tradition, custom, prejudice, suspicion, distrust, jealousy, narrow-minded and short-sighted selfishness or greed, or in general ignorance and lack of understanding one of the other. Most of this latter group bear upon minor or internal as well as upon international co-operation."

The Spirit of Co-operation.

Professor Adams traced the connection between engineering and industrial standardization and co-operation, showing that as a result of standardization the confusing and conflicting claims of competing salesmen are eliminated because the purchaser is placed in possession of definite knowledge of the characteristics or capacities of machines, and thus is able to select discriminately and wisely. But this co-operative spirit apparently does not always prevail. The speaker continued: "Until very recently the French national committee of the International Electrotechnical Commission contained none of the designing or manufacturing engineers, it being assumed that the latter would be biased and partisan in their attitude. As a result the manufacturers formed a syndicate with a committee and standardization rules of its own, which were and even now are to some extent the rules generally employed in France, although much inferior to our own. In some cases the American rules are specified. Even now the French rules originate in the manufacturers' syndicate and are passed on to the French national committee for its approval with a consequent loss of time and efficiency.

"As the work of our own standards committee expanded we found it overlapping the work of other societies in adjacent fields, and co-operative relations were established. This failed from the lack of any suitable and generally acceptable co-operative machinery. A movement was then started by the Institute, more than two years ago, to organize a central body (the American Engineering Standards Committee) to co-ordinate all the work of engineering standardization being done by the various engineering organizations. The objects of this organization are to avoid overlapping, duplication of effort and the confusion of conflicting standards; to insure the employment of an effective and sound procedure in the development of standards, to the end that a standard when promulgated may be not only workable but also acceptable to all concerned and the only accepted standard of its kind; to stimulate desirable standardization and at the same time to shut off premature or ill-advised attempts at standardization.

"The consummation of these objects will mean an enormous saving of effort in the production of standards, a tremendous increase in the value and usefulness of standards, and, when the work is brought up to the needs of the time, an incalculable saving in the cost of production and the productivity of labor. International standardization will be a tremendous stimulus to foreign commerce; but such international standardization is in most cases exceedingly difficult without a central authoritative body with which similar foreign bodies may co-operate. Several instances of this difficulty which have actually arisen during the past two years could be cited. These have resulted in hopeless confusion, misunderstandings and waste of time and money.

"Great Britain has its Engineering Standards Association, which during its eighteen years of life has demonstrated its reason for existence and its value to industry and to the government. The work in air craft standards alone which it is doing on behalf of the government involves some fifty odd sub-committees. France now has its permanent Standards Commission, a little more than a year old, and just getting under way. Holland also has its Normalization Bureau for the same purpose, and Switzerland is just starting a movement in this direction.

"With all these national bodies our American Standards Committee has already established cordial co-operative relations. The American Engineering Standards Committee, although organized last October, is now in process of reorganization; but the success of any such movement is in direct proportion to the degree in which the co-operative spirit prevails. It is the fear rather than the fact that causes the trouble. Even if the sacrifice were much more than it is, however, the price would be small in proportion to the result.

"It is the generous co-operative spirit for which I am pleading, rather than the timid spirit of him whose vision is of such short range that he dare not take a man's size step for fear of stubbing his toe, who holds the little present so close to his eye that it shuts out the whole landscape of the future, whose immediate self-interest or small-group interest is so dominant as to hide anything beyond.

Industrial Research.

"Another fertile but as yet little cultivated field for co-operation," Prof. Adams went on to say, "is that of industrial research. Here we have a field where the obstacles of the second group are specially dominant—particularly short-sighted self-interest and corporate interest and the timid desire for secrecy. That many of the most important and revolutionary developments of modern industry are dependent upon research needs no proof. It is not so obvious to many, however, that co-operation in industrial research is to any large extent feasible at the present time.

"After some experience in this field I am convinced that thorough-going co-operation in industrial research would mean not only a reduction of the cost of research to a small fraction of its present figure, a much more rapid industrial development of the country as a whole and a material increase in the productivity of labor, but also an increase in the profits of every intelligent party to the co-operation.

"Serious co-operation of any kind between widely separated groups is practically impossible without the mechanism of transportation and communication provided by the work of the engineer. Also, with this mechanism developed even to its present degree of perfection, co-operation becomes not only possible but also desirable and necessary, even between comparatively widely separated groups. Moreover, the problems which confront the world at this time are largely a direct result of this mechanism. Are we as engineers going to leave their solution to others? Are we going to be satisfied to play alone in our own little backyard and never look around us even after most of the fences have been removed by our own work? Are we going to fail to take an interest in our neighbor who has much that we need, from whom we have much to learn, and by co-operation with whom we can profit broadly? If we do offer co-operation, is it to be with the provision that we gain all and sacrifice

nothing? Are we going to be satisfied to sit back and criticise destructively the details of a co-operative agreement, priding ourselves on our critical faculty, however valuable that may be at times, when the real basis of the criticism is either intellectual pride or short-sighted fear that we, as individuals or as a group, may lose a little of our independence or prestige; when the issue at stake is in some cases of such paramount importance even to us as individuals—had we only the vision to see it—as to overshadow our very existence?

"Let us rather make use of the logical habits of thought and freedom from bias which at least should be the result of our training and take our part in the solution of the problems we have helped to create. Let us see the goal ahead and start for it without thought of fear or favor, as sure-footedly as possible, but with that generous co-operative spirit which will surmount many an apparently impossible barrier, critical of details if so minded, but generously and constructively so."

Monopolies of Labor and Capital.

Professor Adams then dwelt upon the serious problems arising from the worldwide unrest in the labor group in the following words: "It is very easy to criticise and condemn this attitude because of its unreasonableness, looking down from our superior height of intelligence. It is very easy to assume that it is merely a matter of showing the laborer the error of his ways and of forcing him into line. But would it not be wiser at this time to examine our own attitude with equal care, to make sure that we are setting an example which if followed by labor would solve the problem? Is demanding 'all the traffic will bear' under the pressure of organized labor any worse than the same policy carried out by the capitalist whenever he has the monopoly grip? Unfortunately the two cases are not treated the same by our laws. Labor monopoly is not subject to the same limitations and responsibilities as is capital monopoly. That disparity should be removed. But there are two forms of monopoly other than of labor which are not only not limited by but are actually fostered and protected by our laws, and in which the only limitation ever dreamed of by the owner is 'all the traffic will bear.' These are patents and titles to land."

Professor Adams then explained at length these monopolies showing that it was incumbent on the engineer to assist in a progressive rational evolution of society rather than encouraging and inducing a revolution by a reactionary policy.

The Duty of the Engineer as a Citizen.

"Are we sincere in our desire to be more recognized in our broader capacity as citizens and to be consulted in matters of broad public interest if we are not sufficiently interested in those matters to make an intelligent study of them, if we are satisfied to accept without analysis the prejudices and propaganda of a biased group, however intellectually superior that group may consider itself, if we cease to utilize our logical habits of thought, our habit of analysis, of demanding the reason why, as soon as we step outside of the realm of those physical laws which force us to think straight? Are there no laws in this other realm of human relations which are just as inexorable as the physical laws with which we are so familiar? Is there no law of compensation which is the counterpart of our law of conservation of energy? Are we going to be allowed to go unpunished for crooked or careless thinking in this other realm any more than in the purely physical realm?

"What can we expect of labor in the way of intelligent fair-mindedness if we, with our superior advantages, encourage the perpetuation of institutions which work for serious injustice to the many for the benefit of the few, or even if we allow them to persist because of our lack of intelligent fair-mindedness?

"My opinion as to the seriousness of the present world situation, as to the importance of the problem before us, is not mine alone but that of many thinking men in this country and in others. I have talked with many influential men in France and England and have found a striking unanimity on this point.

"May we not as engineers utilize our training and experience, our method of thought of which we are so proud, to encourage clean, straight, unbiased and fair-minded thinking, and to encourage that broad, generous co-operative spirit which will mean so much in breaking down the barriers which separate classes within a nation, as well as the nations themselves, and which is essential to the solution of the world problem which is knocking so hard at our door?"

Discussion at Tuesday Morning Technical Session.

In responding to President Adams' introduction, the president-elect, Calvert Townley, expressed his appreciation of the honor conferred on him and especially of the opportunity for leadership. He contended that engineers should be just as able to be prominent in the public eye during peace times as they have been during the last few years in helping to carry the war to a successful conclusion. He could not see any far-reaching danger in the present labor agitation because he declared that any body which seeks to secure more benefits than are due it cannot succeed.

The first paper of Tuesday morning's session was presented by H. R. Woodrow, D. W. Roper, O. C. Traver and P. MacGahan on "Present-Day Practice of Transmission and Tie-Line Protection," an abstract of which appears elsewhere in this issue.

Two papers on grounding the neutral were presented at this session—one by H. R. Woodrow and the other by William E. Richards. In his paper, Mr. Woodrow said that experience had unquestionably shown that cable stresses are considerably relieved by grounding the neutral. Further, it is believed to be desirable to limit the ground current as much as possible, thereby reducing the stresses on the system, and particularly the burning of the lead sheath and grounding connections. The installation of grounding relays, set to disconnect a feeder more quickly than the straight normal-current relays, will further greatly relieve the potential stresses resulting from prolonged grounding current which occur even with a grounded system.

Mr. Richards in his paper said considerable improvement in operation has been observed since changing from an ungrounded system to a directly grounded Y system in Toledo, where about 16,000 kw. is transmitted over 23,000-volt, 25-cycle transmission circuits connected with underground cable.

The papers presented at the Tuesday morning session were on relay protection and grounding of the neutral and the discussion of these papers was taken up at the same time. The following were among those taking part in the discussion: Philip Torchio and H. R. Woodrow, New York Edison Co.; D. W.

Roper, R. F. Schuchardt, Commonwealth Edison Co.; H. C. Albrecht, Philadelphia Electric Co.; A. H. Lawton, Consumers' Power Co.; J. A. Johnson, E. A. MacKenzie, Don Carlos, Ontario Power Co.; F. L. Hunt, Turners Falls Power & Electric Co.; P. H. Adams, N. L. Pollard, Public Service Electric Co.; W. de L. Carr, United Gas Improvement Co.; R. R. Honaman, Bureau of Standards; A. E. Silver, Electric Bond & Share Co.; E. T. Moore, Halcomb Steel Co.; J. C. Parker, University of Michigan; H. B. Vincent, Day & Zimmerman; Chas. Proteus Steinmetz, J. R. Craighead, E. F. Creighton, E. G. Merrick, of the General Electric Co.; P. M. Lincoln, F. D. Newberry, F. C. Hanker of the Westinghouse Electric & Manufacturing Co.

Discussion on Relay Practice.

Terminology used in connection with relay practice received considerable discussion, some of the speakers even objecting to the classification of devices given by the protective devices committee.

J. R. Craighead declared that the future practice in designing or extending transmission lines should take into consideration the principles of protection as well as economy. Furthermore, increase in speed of operation of oil switches has required a corresponding improvement in relays. By so doing he believes it will be possible to reduce the time differential of delays below the ¾ sec. now believed to be the minimum. One of the greatest opportunities for improvement will be through the thorough understanding of operating conditions by actual measurements of current, etc.

J. A. Johnson expressed the belief that improvement could be made on combined use of under-voltage and over-current relays by letting the under-voltage relay control the current supplied to the tripping bus. This scheme has been successfully used at Niagara Falls in the generator neutral. Greater improvement in circuit breakers will have to be looked to in the future for isolating cable faults.

Mr. Albrecht said the cycle counter is used extensively at Philadelphia for setting and checking relays. A differential of 25 cycles is allowed for relays, 15 cycles for the oil switch to operate and 10 cycles for inaccuracy of relays. It was his opinion that it is impracticable and expensive to test on the primary side of current transformers as suggested in Mr. Woodrow's paper declaring that too much emphasis is placed on the reduction in busbar voltage during short circuits.

P. Torchio admired the ideal to which Mr. Johnson aimed, namely, a circuit breaker which would open any short circuit, but said it is too far in the future. The better way to do, in his opinion, is to reduce the amount of power that can go into a short circuit in order that the selective relays can be properly applied. He contended that it is better to follow this American development than to change to European practice.

P. M. Lincoln pointed out that the possibility of interruption of service is increasing with the increase in size of electric service systems, while there comes a greater need of reliable service. Hence there is vital need at this time and in the future for considerable investigation of the protection of large systems in order to offset these contending factors. In this connection it is encouraging to note that the efficacy of grounded neutrals is fairly well demonstrated, companies in Toledo, New York and Montana having reported favorably.

Dr. Steinmetz said the problem of relay protection is the production of simple, reliable and automatic apparatus that will permit an abnormal circuit, cable or piece of apparatus to be disconnected without interfering with the operation of any normal line or cable. When disturbances occur, normal circuits as well as the circuits in which the disturbance takes place are affected, so that devices that indicate or act merely when abnormal conditions take place will not solve the problem because the conditions require a device whose operation depends on the magnitude of the abnormality.

R. F. Schuchardt stated that engineers have been slow to recognize that relays reduce investment expense, due to the saving possible through interconnection. Now, he contended, it is very largely a case of providing the proper talent to maintain relays in order that the manufacturers may know where further improvement may be made. He suggested that the protective devices committee serve throughout the coming year as a clearing house on experiences with relays to permit an interchange of information on this subject. Chicago probably has a larger system in a limited territory than probably any other company; the conditions met there may be the same as those of other systems in the near future, so their problems and solutions are worthy of considerable study by such companies. On this system the circuits are sectionalized by reactors to limit the power which can be supplied to any fault. In each section one unit is grounded through a 2½-ohm resistance.

Don Carlos queried the need of so small a total time interval as two seconds in relay setting. The Ontario Power Co.'s system allows a total interval of eight seconds, while on an associated system four seconds is maintained without trouble, owing to the long time setting. It would be impossible to maintain the setting of ¾ sec. between relays with satisfactory results, he said, at least double that time being necessary with the equipment in use.

E. P. MacKenzie said that automobile batteries of both the lead and Edison types have been used for operating relays by the Ontario Power Co. The lead type appears to be more economical for this particular purpose, although dry cells are still more so. The latter are being used by some companies even for 110-volt oil-switch control. He recommended the method of Mr. Johnson of using under-voltage relays to control the tripping bus in conjunction with over-current relays, a master relay being employed for a similar purpose on the Ontario system with satisfactory results. For generator protection Mr. MacKenzie advocated definite-time relays. He does not consider it necessary to set relays from the primary side of the transformer but recommends testing them after each automatic operation for characteristics, including minimum current required to operate them.

E. G. Merrick considered it hardly necessary to reduce the total operating time of relays and switches below 2 sec. to protect generators and transformers as they can withstand short circuits for this period of time. On the Montana Power Co.'s system higher reliability of relay operation has been obtained by grounding neutrals, about the only trouble now experienced being on account of the high resistance of grounds.

D. W. Roper said that tests conducted by the Commonwealth Edison Co. show that if relay action is not very rapid, synchronous apparatus will be thrown out of step when a short circuit occurs very near the equipment. However, if the short circuit occurs some

distance away, increasing the reactance and resistance of the circuit thereby, this trouble will not be so acute if the relays and switches operate properly. Since the effect of burn-outs in cables and the spreading of damage is more severe when a time element is introduced into relays, it is vitally important that rapid relay action be obtained.

P. H. Adams believed a total time interval of 2 sec. might be satisfactory to maintain in relay settings for short-circuit conditions, but it might be shorter for mere overload conditions.

F. L. Hunt, Turners Falls Power & Electric Co.; A. E. Silver, Electric Bond & Share Co.; N. L. Pollard, Public Service Electric Co., New Jersey, all corroborated the benefit resulting from the grounded neutral.

J. C. Parker said that relay application should not be considered so much from the viewpoint of protection of apparatus as from that of insuring continuity of service. If this distribution is made, the problem of determining time settings is considerably simplified. Engineers too often fail to recognize that the ultimate object of central stations is to give continuous service. Mr. Parker cited one instance in which a company lost about $500,000 in revenue from two consumers through failure to eliminate interruptions. This loss is sufficient to justify considerable investment on relays.

E. F. Creighton, in closing the discussion, pointed out that balanced relays sometimes trip when circuits are being synchronized owing to the switch blades failing to make contact simultaneously. While the arcing ground suppressor was very effective when used on radial systems, it is not at all satisfactory now on parallel feeders.

H. R. Woodrow closed the discussion on relay protection and grounding neutrals by answering comments made during the discussion. He emphasized the fact that the time interval between relays depends on several factors, including relay characteristics, time required for switch operation, and nature of the system of which the apparatus is employed. While some oil switches have a speed of operation as high as ¼ to ½ sec., others are slower, hence the time interval of ¾ sec. is not so far wrong. Until high-speed breakers are developed there is no way of reducing the time interval near the generators, although this would be desirable. It may be possible to reduce the total time interval below 2 sec. on large systems, although on smaller systems a long interval is permissible. Referring to the possibility of synchronous apparatus falling out of step, Mr. Woodrow pointed out that there will be less tendency to fall back into step again if the time interval is increased. Comparing single-turn and multiple-turn current transformers, it was pointed out that the former are very accurate on overloads, but that the accuracy depends greatly on the secondary load, which may cause the speed to range from ½ to ¾ sec. For this reason it is advisable to use the primary-test method recommended instead of applying current directly to the relay terminals. The next best method, so far as accuracy of results is concerned, is to apply the test on the secondary terminals of the current transformer. It is not essential to test beyond the flat part of the relay characteristic curve, in Mr. Woodrow's opinion. Unless current is limited considerably by reactors, Mr. Woodrow believes 8 sec. is too long for the total time interval because all apparatus will not withstand full short-circuit current without injury. In addition to using short-circuit protective relays, the company with which Mr. Woodrow is connected employs ground relays to clear faults before they develop into short circuits.

Technical Committees Make Their Reports.

Notwithstanding the stress of the last year resulting from the war, the technical committees were able to collect a large amount of information and important data. The reports of these committees are abstracted as follows:

Power Stations Committee Reports.—Philip Torchio, chairman, advocated changes that would tend to improve the character of the papers and their discussions. He suggested that each committee discuss the papers before they are submitted to the membership; committees should put them into best form, revise them and endeavor to have them presented at general meetings. Committees should encourage and plan discussion and the work of many of the committees might be made broader and even overlap into the work of other committees and the work even of other engineering societies. For future work a paper outlining statistical data essential to recording power-plant efficiency was proposed, relative merits of shunt and compound-wound exciters, steam and motor-driven units, etc., also are to be taken up.

Comfort A. Adams emphasized Mr. Torchio's remarks, laying special emphasis upon the benefit that will accompany closer co-operation with authors in presenting accurate, suitable and concise papers. Prof. Slichter, Columbia University, mentioned that future national meetings will be more dignified than preceding meetings, hence great care in the selection of papers will be more imperative than ever.

Committee on Telegraphy and Telephony.—Some of the many developments and improvements made during the war were reviewed by Donald McNicol, chairman. Much improvement was made in apparatus for protecting telegraph and telephone lines against lightning. Closer co-operation between power companies and telegraph and telephone companies was coming about, thus assisting to reduce inductive interference between the heavy and the small-current circuits. The vacuum-tube amplifier has been highly developed and is today the preferable form of amplifier for long-distance telephone transmission.

Committee on Instruments and Measurements.—S. G. Rhodes, chairman, told of the activities of this committee in connection with the War Department and the Bureau of Standards, in which much assistance was given toward standardizing the specifications for purchasing electrical instruments. Improvements of thermocouples for accurate measurements of alternating currents at any frequency was dealt upon, these thermocouples being superior to any German couples on the market at the time the war began.

Committee on Industrial and Domestic Power.—During the year each of the various committees on application of electricity to machine tools, the cement industry, motor characteristics, to the textile industry, etc., confined and concentrated its efforts to its specialized branch. Chairman H. G. Pierce recommended that the personnel of the committee be retained intact and the work now underway be continued. The work of these committees in the printing, elevator and machine-tool applications was reviewed.

Committee on Electrophysics.—F. W. Peek, Jr., chairman, outlined the aims of his committee as being to encourage papers of a high technical standard dealing with advances in electrophysics; to have at least

one broad general paper dealing with modern physics, but free from mathematics; and the promotion of closer co-operation and mutual understanding between the physicist and the engineer. The need for keeping engineers in closer touch with the work of the physicists was emphasized.

Committee on Lighting and Illumination.—This report touched upon the demands created by the war and what tendencies are to be expected now the war is over. Considerable activity in street lighting is to be looked for now that war-time restrictions have been removed. Developments in street lighting and the application of some form of prismatic reflector for incandescent street illumination was mentioned. Some of the achievements in lighting during the war were reviewed, including the perfection of the Lynn searchlight for military and naval purposes.

Marine Committee.—The enormous activity in marine matters necessitated subdividing the Marine Committee into sub-committees known as ship installation and electric ship propulsion committee, respectively. The former has been again divided into lighting, power apparatus and distribution committees. A number of matters taken up by the power apparatus and lighting sub-committees and not considered by the main committee were reviewed and proved to be of interest.

Committee on Iron and Steel Industry.—The iron and steel industry absorbs the largest amount of electrical energy of any one industry, the motor equipment alone requiring 650,000 kw. in generator capacity to care for it, while electric furnaces are absorbing 900,000 kw. There is great need for and enormous possibilities in standardization of electrical apparatus employed in the iron and steel industry, states Eugene Frielaender, chairman of the committee. He advocates much closer co-operation with the Association of Iron and Steel Electrical Engineers and advocated that the A. I. E. E. go much farther than it has done so far toward standardizing the mechanical dimensions of pulleys, shafts, gears, etc.

Committee on Electrochemistry and Electrometallurgy.—In submitting his report, Chairman Carl Hering advocates that papers dealing entirely with matters electrical such as regulation, power-factor, etc., be delivered either before the A. I E. E. or, better still, before joint meetings of the A. E. S. and the A. I. E. E. Co-operation between the two societies is the keynote of this report.

Committee on Protective Devices.—D. W. Roper, chairman, recommends that the following phases of relay protection, oil circuit-breakers, grounding the neutral, lightning arresters, current transformers and potential transformers be investigated from the aspect of protection. Developments and improvements depend very largely upon the operating companies whose experiences enable new or modified apparatus to be evolved to meet new problems as they arise. The paper, entitled "Transmission Line Relay Protection" (appearing in abstract elsewhere in this issue), represents a large part of the work of this committee.

Committee on Transmission and Distribution.—This report, presented by E. B. Meyer, chairman, showed the committee had been very active during the year in tackling the problems of insulators and underground construction. A number of papers have been delivered on allied subjects. It is advocated that depreciation be given more consideration in reducing insulator failures and service interruptions. The tendency is to go to higher voltages. Research work in connection with dielectric losses in subteranean cables, standardized test methods and the compilation of data on operating temperatures of underground conductors are some of the matters brought up.

Committee on Use of Electricity in Mines.—As a result of this committee's activities, several papers on matters pertaining to mining have been presented before the society. The report recommends closer co-operation between the various technical national and local engineering societies.

DUQUESNE LIGHT CO. REDUCES RATES FOR RESIDENTIAL SERVICE.

New Schedule of Pittsburgh Central Station Company Based on Maximum Demand Charge.

Effective July 1, the Duquesne Light Co has placed a new schedule of reduced rates for residential electric service into effect. The new charge is at the rate of 8 cents per kw-hr. for the first 30 hours' use of the customer's demand; for the next 60 hours, 6 cents per kw-hr., and for all consumption in excess, 3 cents per kw-hr.

The customer's demand in the new rate is based on the number of lamp outlets, the first 10-lamp outlets being rated at 30 watts each, the next 20 at 20 watts each, and all in excess at 10 watts each. The company will still maintain its fixed service charge, which provides for a rate of 15 cents per month graded to 5 cents for apartment houses, hotels, etc. The minimum fixed service charge is 65 cents per month, with a rate of 6 cents per kw-hr. and discount of 1% per kw-hr. for prompt payment of bills. Local electric companies in the retail branch of the trade are using the reduced rates as an incentive to consumers to purchase electrical appliances of different kinds with considerable success.

BALL BEARINGS FOR CONSERVING ENERGY.

Introduction of This Equipment for Power Plant Use During War Proves Successful.

When the coal shortage became acute last year, central stations and others set about reducing needless wastes of energy that were small individually but represented quite a large total when taken in the aggregate. Apparatus was operated so that the most efficient units were kept in service as long as possible, apparatus not actually used was taken out of service so as to reduce core losses, which react back to the coal pile. Needless friction was eliminated wherever possible.

In reducing friction in power plants one of the practices that came was that of employing ball bearings in places where they had previously been considered ill-adapted. Even in places such as the boiler room—proverbially dirty and grit and dust laden—ball bearings have been used for shaft and stoker drive. Tests made of the relative friction losses of a 3-hp. induction motor with ball bearings, waste-packed bearings and ring-oiler bearings showed efficiencies respectively of 84, 80.5 and 81.5%. An efficiency difference of 2.5% in favor of the ball bearings becomes a matter of importance where a machine operates continuously for a high portion of the year and where there are many machines.

Transmission Line Relay Protection

Review of Typical Applications of Current and Directional Relays—Excerpts from American Institute Paper

By D. W. ROPER, H. R. WOODROW, O. C. TRAVER and P. Mac GAHAN

THERE was a time when the protection of an electrical tranmission system with the single generating station and its radial feeders was not a matter of very grave importance. That time, however, has passed and the multiplicity of generating stations with tie lines and parallel feeders have greatly complicated the once simple problem. Furthermore the practice of interconnecting large transmission systems has brought about conditions which require very serious consideration when laying out a protective relay scheme. An effective sectionalizing relay scheme is necessary in order to secure both continuity of service and maximum efficiency of transmission, and the most complicated system can be effectively relayed if all the conditions are thoroughly analyzed and proper relays, carefully set for both time and current values, are applied.

Most of the large systems of the present day have grown out of a comparatively small beginning, stations and lines being added as required, without taking into consideration the relay problem. As a consequence this problem has, in a great many cases, become rather difficult and it has become evident that the application of protective relays for sectionalizing trouble is one of the principal features to be considered in determining the design of a transmission system. This point should be borne in mind whether additions are being made to an existing system or whether an entirely new system is being designed. Numerous instances could be given, if space permitted, whereby a slightly different design in extending lines and adding stations would have given a much more simple and effective protective scheme.

The same argument applies to the design of an entirely new system, particularly if it is likely to become very complex, and in so far as practical, possible extension should be considered in the original layout so that various methods of protection can be studied and their advantages weighed against possible disadvantages of a design to which they can be applied. It will be found in practically every case that one of the many sectionalizing schemes now in use can be combined with a proper layout of stations, transmission and tie lines to give proper selective action. Thus the many difficulties encountered when attempting to apply relays to a system laid out without regard for its protection may be avoided. It is therefore of paramount importance that the selective features of various types of relays be thoroughly analyzed before adapting them to any particular system.

The most perfect relay system cannot be expected to give the best results unless the man in charge of its installation and operation be thoroughly competent and familiar with the various precautions to be taken. It is absolutely essential that he know the characteristics and peculiarities of the relays as well as the scheme he is using. Results of experience have shown that an experienced man will secure more satisfactory results from an inferior type of relay than a less capable man can secure from the best equipment obtainable.

One of the principal factors controlling the settings of relays is the amount of short-circuit current available under various conditions as outlined later in this paper.

The proper type of relays to be selected for protecting transmission lines is dependent upon whether the system is operated radially, in parallel by groups, or in loop, and the time allowable for holding a short circuit on the system. In general, however, the most simple form of relay protection where several parallel feeders are involved is the straight inverse-time current relays which are set to give times of operation which are progressively longer as the source of power is approached. In some cases, however, where an extended system is considered, the time requirements for the relays approaching the generating station are so long that it is considered dangerous or inadvisable to hold short circuit currents on for this period. We believe a delay of two seconds to be the extreme time a dead short circuit should be allowed to remain on a system, except under very unusual conditions.

The introduction of directional relays at points where power is feeding into a station will materially reduce this maximum time setting as these relays can be given a short time setting as outlined later under the heading, "Typical Applications of Current and Directional Relays."

Another method of shortening this time is by the use of the balanced system, in which case current can only flow through the relay at time of short circuit as outlined later under the heading "Balanced Protection Schemes."

Another method has been developed for shortening this time by the combination of an under-voltage relay with the inverse time current relay, as outlined later under "Combination of Under-voltage and Overcurrent Relays for Protecting Tranmission Lines."

For relay protection on tie lines, between generating stations in general, the conditions are somewhat similar to the straight transmission line relay protection if the additional precautions are taken to prevent operation on heavy momentary surges of power that are likely to exist between two or more generating stations at time of synchronizing or momentary disturbances on the system. The relay desired here is dependent to a large extent upon the method of system operation, as in some cases an operating company will want the tie lines to open, in case of trouble on a portion of the system, whereas other companies want these tie lines held rigidly in service in all cases excepting in case of trouble on tie lines themselves. In the first case shorter time settings are given to the relays and the application of straight inverse time current relays with the possible application of directional relays, is all that is required. In the second case, however, application of some form of a balanced relay, as described later, may become necessary. If the tie

lines are not to stay in indefinitely, inverse-time current and directional relays with long time settings would give a very suitable operation and allow the tie lines to open in case of more serious trouble on either side of the system.

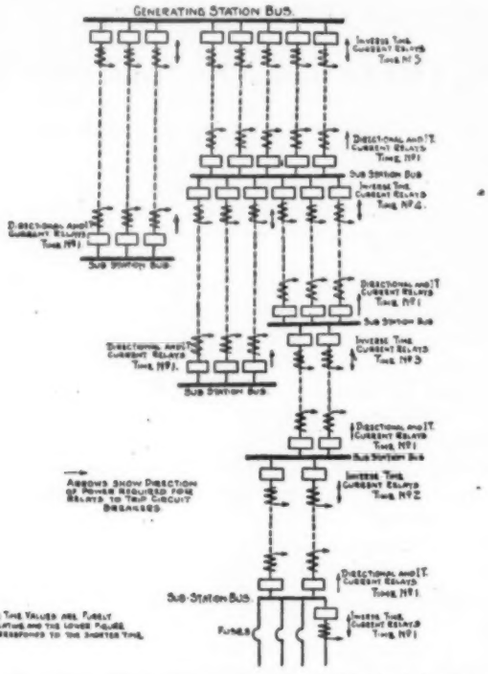


Fig. 1.—Inverse Time Current and Directional Relays as Applied to Parallel Feeders.

Some companies have connected their control and tripping circuits to the excitation bus, thereby obtaining the advantages of direct current, but sometimes this has led to considerable trouble due to the unstable conditions of this source, especially under alternating-current short circuits. It has resulted occasionally in a complete disabling of the control system on account of abnormally high induced voltages on the excitation bus with single-phase short circuits on the alternating-current generators. Great precaution should be taken against these conditions and for best results we feel that an auxiliary supply should be used if possible for obtaining at all times a constant power for the tripping circuits.

Typical Application of Current and Directional Relays.

The combination of inverse time current relays with directional relays is becoming very extensively used in cases of parallel operation of lines or of feeders forming a ring system.

Some of the trouble which was experienced in the early days was mainly due to the difficulty in obtaining a directional relay which would operate correctly under all conditions of faults, especially where low voltage was encountered. The directional relays produced at the present time are apparently giving very satisfactory results, even under low voltage conditions down to 1% of normal, and may be applied to loop or parallel group systems in series, in combination with inverse time current relays, if a careful analysis is made of the proposed installation.

For the protection of parallel groups in series, the relays are applied as shown in Fig. 1, with inverse-time current relays placed at the transmitting end and directional relays (combined with an inverse-time current element) at the receiving end. The directional relays are connected to close their contacts for power flowing from the bus to the line, and these contacts are placed in series with those of the inverse-time current relays of the same circuit so that the circuit-breaker is tripped only in case of power flowing in the direction away from the bus and of a magnitude exceeding a certain given amount for a certain time. Any time delay required is provided by the adjustments of the inverse-time current relay element.

For protecting the loop system both the inverse-time current and directional relays (with inverse-time current element) are used, as shown in Fig. 2. Each line, at each station, is provided with inverse-time current relays. Where these inverse-time current relays are given the lower time settings, directional relays are also used with the tripping contacts connected in series, so that both relays must operate before the circuit-breaker is tripped.

Reference to the time settings given in the diagram (purely relative) will show that they are graded on the same basis as a single series of tandem-connected substations, assuming that one end of the loop is open at the generator bus, and neglecting those breakers which would be incoming at the various substations. It should be noted that when the other end of the loop is considered open, the substation breakers which in the first case were incoming will now be outgoing, and *vice versa*. The directional relays are also installed if the time of an incoming line is lower than an outgoing line further from the source. This must be checked separately for each end, in turn, considered opened at the generator station.

To secure the operation of the directional relays under bad power-factor conditions, connections are made so that the maximum torque is obtained with lagging power-factor. This may be accomplished by

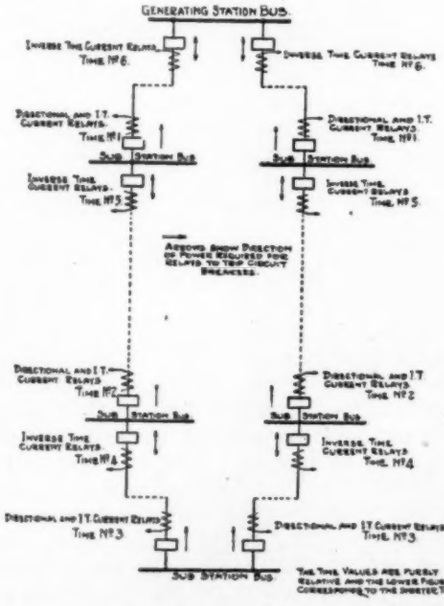


Fig. 2.—Inverser Time Current and Directional Relays as Applied to Ring System.

using directional relays with step-down transformers several schemes of connections of the potential and current elements, which schemes may not be interchangeable with different types of directional relays.

Some operators have found it advantageous when (particularly if not paralleled on the primary side) or reactors, to connect the voltage elements of the relays to the bus side of this apparatus in order to give a higher voltage in case of short circuit, thereby obtaining better operating conditions for the directional relays.

Balanced Protection Schemes for Transmission Lines.

Many operating companies have installed on a portion of their lines protective equipment designed to be inoperative so long as the currents in different circuits or at different points in the same circuit are substantially equal. To this end they have made use of (a) fully insulated lines in parallel between stations, (b) conductors in parallel having reduced separating insulation, *i. e.*, split conductor cable, and (c) pilot wires of relatively small cross-section between the two ends of a line to sense the degree of balance of the currents at these points. The basic principles involved are discussed below, which principles are sufficiently flexible to allow application in various ways to the problem which may be in hand.

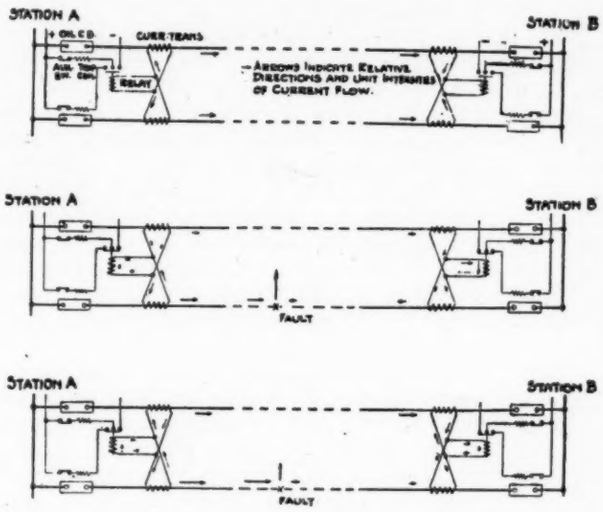
In the various diagrams accompanying the descriptions of these balances schemes, arrows are inserted to indicate the relative direction of current or of power. These arrows show power normally flowing from station A to station B. In each case, however, the equipment is equally suitable for power flowing in either direction.

In general, the over-current relays used are adjusted to operate instantaneously or nearly so. Some companies report that the opening of the breaker is so rapid that there have been cases where a cable has immediately rehealed, due to hot insulating material flowing into the opening made by the fault. Usually the point of breakdown has been actually located by subsequent inspection.

Balanced Protection of Two Parallel Lines (Not Discriminating).—The exceedingly simple scheme of balanced protection illustrated (Figs. 3, 4, 5) has given excellent results in a system so arranged that the lack of discrimination on the part of the relays between the sound and the injured line of a pair is not very vital. On the system referred to, each substation having such relay scheme, is provided with power over at least two different groups of lines. The complete, though temporary, interruption of one of these sources does not therefore kill the bus in question, and no hardship is imposed greater than the inconvenience of determining the good line preparatory to replacing it in service without its mate. This inconvenience is to a considerable extent compensated for by the freedom of the equipment from all alternating-current potential connections. While these potential connections, in present day relays, do not occasion the misgivings they were responsible for in older types, their elimination is a point not to be overlooked.

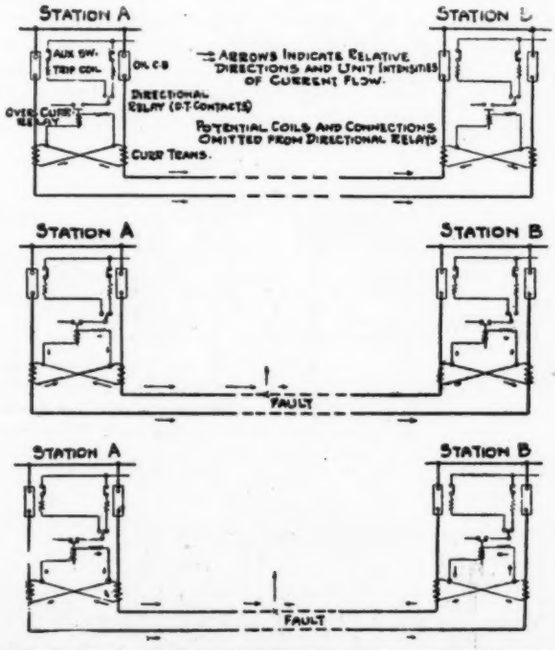
The balanced equipment, as shown above, consists of "cross connected" current transformers in the similar phases of the two lines, to the equi-potential points of the secondaries of which an over-current relay is connected. So long as the currents are equal and in the same direction in the two lines, there will be no current to flow through the relay coil, as demonstrated by the arrows on the secondary circuits. A through short circuit will not, therefore, improperly open these circuit-breakers providing the line characteristics are such that a suitable balance is maintained.

Assuming a fault, as shown in Fig. 4, there is an unbalance of currents at substation A and a relative reversal of current at substation B. The differential



Figs. 3, 4 and 5.—Balanced Protection for Two Parallel Lines (Not Discriminating).

of the secondary currents pass through the over-current relays, being an arithmetical difference at substation A and an arithmetical sum of substation B. Due to the differential current in the relay coils, the latter cause contacts to close, which trip both circuit-breakers at each end of the two lines. Following such operation it is reported to be the practice to find the healthy line and connect it in service with time over-


STATION A
STATION B
ARROWS INDICATE RELATIVE DIRECTIONS AND UNIT INTENSITIES OF CURRENT FLOW.
DIRECTIONAL RELAY (D.T. CONTACTS)
POTENTIAL COILS AND CONNECTIONS OMITTED FROM DIRECTIONAL RELAYS
CURR. TRANS.
FAULT

Figs. 6, 7 and 8.—Balanced Protection for Two Parallel Lines (Discriminating).

current protection (not illustrated in the diagrams) in place of the differential protection. If, at any time, the fault should occur so near station B that the currents at station A remain balanced, then the station A

relay would not operate immediately, but at B the differential current would be very great, due to the reversal in the relative directions. Station B would, therefore, clear quickly, after which there would be established a large differential at A. An open circuit in either of the lines will likewise unbalance the pair and result in its isolation.

In order to protect against short circuits on the substation bus itself, or any possibility which would not give a relative unbalance or relative reversal of current on a parallel group of lines, the generator ends of all feeders are provided with inverse-time limit relays having comparatively high settings. It might be added here that with faults on the feeders between the generator station and substation, the substation relay clears the pair of lines from the substation, usually so quickly that the inverse-time limit relay on the faulty line only at the generator end trips, thus leaving the good line of the pair connected at the generator substation.

Assume now a restricted fault in one of these lines, Fig. 5, such that the power direction remains throughout as formerly although the intensities have changed. It will be noted that the resulting difference in the currents in the two lines is reflected in the secondaries where it appears as a current through the relay coils and, causing the contacts to close, trips both circuit-breakers at each end of the two sides.

Balanced Protection for Two Parallel Lines. (Discriminating.)—In order to obtain discriminating action in the relay equipment for short circuits in either of two parallel lines, direction relays are included in the scheme previously shown in Fig. 3. With this modification the arrangement is as illustrated in Fig. 6. It should be noted that in case of an open circuit in one of these, selective isolation of the broken line is not obtained. The resulting unbalance would cause the opening of the sound feeder at one end and of the broken circuit at the opposite end, in case of sufficient current flow, as determined by setting of the time-current relay.

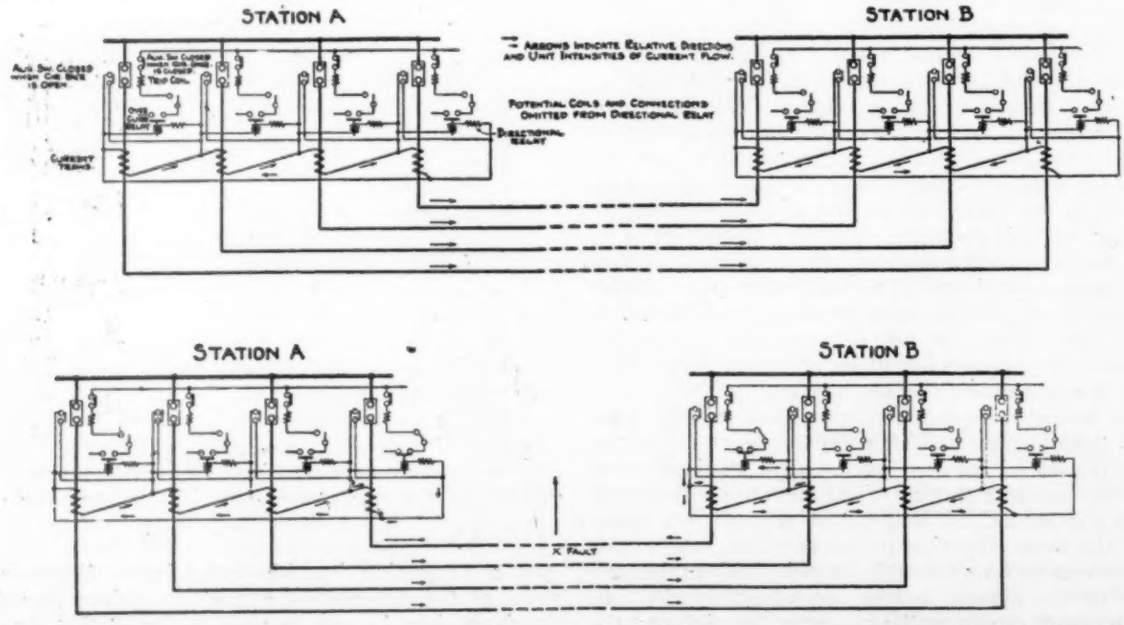
As in the previous case, so long as a balance is maintained between the corresponding phases in the two lines, no current flows in the differential or relay circuit. When a fault occurs, however, the vectorial unbalancing in the main circuits will be indicated in the relay coils, as illustrated in Figs. 7 and 8.

Looking at the matter from another viewpoint, if we assume for the moment that only one line is in service, then the current and potential connections to the directional relay should be so made that for power flowing from the bus to the line the contacts would close on the side to trip the breaker of the line in service. When both lines are working, the circuit having the greater flow of power from the bus to the line will control the operation of the directional relay and, therefore, trip the breaker of the line in trouble which always carries the greater power from the bus to the line.

It should be born in mind that power flowing from the line to the bus is of negative value, therefore, for cases such as shown in Fig. 7, where power flows from the line to station B bus over both circuits, the circuit having the greater flow from bus to line is the one having the least flow from line to bus.

In the event of one line being in service alone, it is the general practice automatically, by means of auxiliary switches on the circuit-breakers, to introduce time, over-current relays in the protective equipment which will operate in conjunction with the directional relays in a manner similar to that described in connection with Fig. 1 or Fig. 2 (tandem groups or loop circuits). This time delay also serves to prevent the opening of the sound line immediately following the tripping of the faulty one. In place of the single directional relay with double throw contact, it is also possible to obtain substantially the same results with two sets of relays with single-throw contacts arranged in a manner similar to that described for the protection of three or more parallel lines and shown in Fig. 9.

Balanced Protection for Three or More Parallel Lines (Discriminating).—Where a number of parallel lines are involved the underlying feature is the same as described in connection with Fig. 6, although the treatment of the matter is necessarily different. Here,



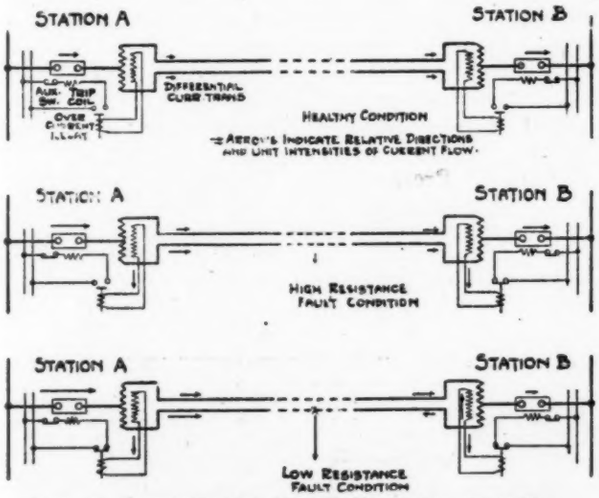
Figs. 9 and 10.—Balanced Protection for Three or More Parallel Lines (Discriminating), and Effect of Fault in One Line.

as shown in Fig. 9, the current transformer secondaries are connected all in series in a loop circuit so that, when the primary currents are all equal, the secondary currents will also be equal and will circulate through the loop as one current of the magnitude of each, and practically none will pass through the coils of the over-current and directional relays which are connected across each current transformer secondary.

Fig. 10 illustrates a fault in one line such that power is reversed at station B in this line from the direction taken by the remaining sound lines. It will be observed that only in the case of the injured line is the power direction through the directional relays (as indicated by the arrows) such that the contacts will close. At station A this is because there is a preponderance of positive power flowing from the bus into this particular line. At station B the injured line is the only one having positive outward flowing power.

Inasmuch as the success of the scheme depends upon the relatively low impedance of the loop circuit as compared to the impedance of the coils, it will be apparent that some method should be provided to eliminate the useless impedance injected in the loop circuits by the relays of a dead feeder. This is usually done automatically by short circuiting, by means of auxiliary switches on the circuit-breakers, or by auxiliary relays controlled by such auxiliary switches, the relay equipment of the line whose circuit-breaker is open.

It will be noted that when all but one line is out of service, the relay equipment of this last line will be



Figs. 11, 12 and 13.—Split-Conductor System Protection.

short circuited by the auxiliary switches or relays referred to in the preceding paragraph and accordingly the last line will be non-automatic unless some means is provided to open the loop circuit. This opening of the loop may be accomplished manually or it may be done automatically with considerable complication of auxiliary switches, etc., which complication is usually considered inadvisable. When the loop has been opened, each feeder will be left with over-current and directional protection at values determined by the settings of the over-current relays. Various other, also somewhat complicated, means may be used for inserting additional relays for the protection of this last line which on account of their variety will not be described here.

If an open circuit should occur in one of the conductors or if, when putting another line into service only the breaker at one end is closed, an unbalanced condition will result which may tend to open the good lines in use if the current flowing at the time is sufficiently great. This danger becomes relatively smaller as the number of lines involved is increased because the secondary unbalancing will be inversely proportional to the number of lines in service. For instance, if the over-current relays are set to operate at the normal load of each feeder and if four lines are in

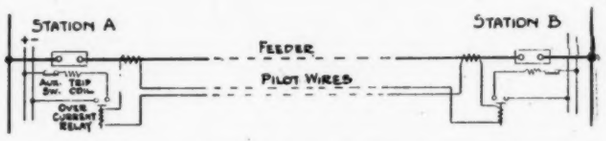


Fig. 14.—Pilot Wire System With Balanced Pressures—Merz-Price System.

(three continuous and one open at one point), an overload of three times normal on each feeder would be required before any trouble could be encountered.

Split Conductor Protection.—Split conductor cables are being tried out in this country by two operating companies who report good results to date. The cable is comprised of six conductors, each of the three phases being "split" into two halves.

The healthy and faulty conditions are illustrated in Figs. 11, 12 and 13. The action of relays is similar to that described in connection with the two-parallel-line equipment shown in Figs. 4 and 5, excepting that under end fault conditions, additional devices are required to provide the necessary unbalancing.

Pilot Wire System with Balanced Pressures.—Adaptations of the Merz-Price protective system have been used by two operating companies. One of these reports very satisfactory results, the other is not so favorable due to an inherent difficulty in obtaining the proper degree of balance.

Fig. 14 illustrates the scheme of connections. The current transformers in each end of the circuit have their secondaries connected in opposition so that when current flows through the feeder, a potential is produced across each current transformer secondary. As

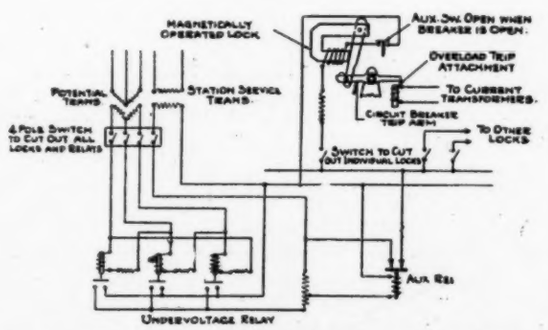

MAGNETICALLY OPERATED LOCK
AUX. SW. OPEN WHEN BREAKER IS OPEN.
OVERLOAD TRIP ATTACHMENT
TO CURRENT TRANSFORMERS.
CIRCUIT BREAKER TRIP ARM
TO OTHER LOCKS
POTENTIAL TRANS
STATION SERVICE TRANS
4 POLE SWITCH TO CUT OUT ALL LOCKS AND RELAYS
SWITCH TO CUT OUT INDIVIDUAL LOCKS
AUX. REL
UNDERVOLTAGE RELAY

Fig. 15.—Undervoltage and Overcurrent Relay-Scheme of Connections.

these pressures, at the two ends of the line, are produced by equal currents passing through similar transformers, they also will be equal and, being in opposition, no current will flow.

If, however, the input to the cable exceeds its output the corresponding potentials across the transformers will become unbalanced and a current will pass through the pilot wires and, at the same time, through the relays connected in series at each end. The oper-

ation of these relays serves to trip the circuit-breakers.

Combination of Under-Voltage and Over-Current Relays for Protecting Transmission Lines.

One of the companies reported an application of a combination of under-voltage and over-current relays for their system which has given them very satisfactory results.

In this scheme all the circuit-breakers in any section are mechanically locked in the closed position by means of a magnetically operated lock. It is controlled by a voltage relay which releases the lock when the voltage falls below a predetermined value (approximately 70%). Upon the occurrence of a short circuit the voltage drops and when it has fallen below the predetermined point the voltage relays act to unlock the circuit-breakers which are then free to be opened by the over-current relay or other over-current device. Thus, in most cases only the breakers in the affected section can open on short circuit. It sometimes happens, however, that when two stations are close together, breakers in an unaffected section may be unlocked but usually the over-current device will act to open the proper ones only and clear the trouble before the others can operate.

Referring to the diagram, Fig. 15, the under-voltage relays are connected to the secondaries of potential transformers on the line buses. An auxiliary relay is actuated from the station service transformer and is controlled by the under-voltage relays. In its turn this auxiliary relay controls the locks on the circuit-breakers. One set of under-voltage relays, with the auxiliary relay, may control a number of locks on a number of circuit-breakers. The operation is as follows:

When the line potential drops below a predetermined value, one or more of the under-voltage relays drop and short circuit the auxiliary relay through a resistance which causes this auxiliary relay to open. This, in turn, releases the latch and leaves all the circuit-breakers under its control free to operate in case of over-current. Thus, so long as the potential remains above the predetermined value, no breaker can be opened by its automatic over-current feature.

This scheme, illustrated in Fig. 15, is reported as giving successful results on an overhead system covering 4000 square miles where there is a large number of stations located on an average of approximately 10 miles apart. As the lowest voltage occurs nearest the short circuit, it is probable that only the circuit-breakers in the immediate vicinity will be unlocked and allow the circuit-breakers to be automatically opened if the current is of sufficient magnitude.

Further information on this subject of relay protection will be found in papers by Philip Torchio entitled "Relays for High Tension Lines," and by R. F. Schuchardt entitled "Protective Relays," A. I. E. E. Proceedings, Vol. XXXVI, 1917, pages 361 and 383, respectively; and a paper by W. H. Cole on the subject of "Split Conductor Cables—Balanced Protection," Vol. XXXVII, page 793, A. I. E. E. Proceedings.

MANUFACTURE OF ELECTRICAL WIRING DEVICES IN OPORTO.

An industry of increasing importance in the consular district of Oporto, Portugal, is the manufacture of electrical wiring devices, according to the recent report of Consul Samuel Hamilton Wiley. This industry is in the hands of a Portuguese company, the Empreza Electro Ceramica, capitalized at about $375,000, fully subscribed, financed by local capital. The factory is located at Vila Nova de Gaya, a suburb across the Douro river from Oporto.

This company was organized about three years ago for the manufacture of the porcelain parts of electrical wiring devices, to supply the local demand for these articles which were formerly imported, chiefly from Germany. The venture has been a marked success, as the company is not only supplying the greater part of the local demand, but is exporting its products in increasing quantities to Spain, France, England and Brazil. Although the war is over this trade is expected to increase.

Output of Factory, Now Large, to Be Increased Shortly.

The plant covers an area of about three acres and consists of a modern installation for the manufacture of all porcelain wiring devices, for both high and low tension, and for the manufacture on a small scale of the metal parts of such devices. The manufacture of the metal parts has only recently been commenced. About 800 workmen are employed, and four large furnaces are operated in the manufacture of the porcelain parts. The preparation of the kaolin for use in the manufacture of the porcelain is carried out in the plant. All the steel molds, fire-clay receptacles, and other accessories employed are manufactured in the plant. With the exception of the metal used, all the raw materials are of local origin and are obtained from nearby. The production capacity of the factory is as follows: High-tension insulators (up to 15,000 volts), 1000 a day; low-tension insulators, 5000 a day; small insulators, fuses, switches, rosettes and other devices, 225,000 a day. With equipment now being installed the company hopes soon to double the present capacity.

Porcelain electrical wiring devices of the various types used in France, England, Spain and Brazil are produced, and many devices of German invention are initiated and improved upon.

American Co-operation Desired.

It is the intention of this company to greatly increase the output of its plant, and to endeavor to secure a large share of the trade in electrical wiring devices in European and South American markets formerly held by Germany. The greatest difficulty in the carrying out of this plan is the manufacture of the metal parts. Difficulty in obtaining raw materials and machinery for the manufacture of these parts prevents their being produced in quantities sufficient to complete the porcelain parts turned out. To insure the best results it is necessary to adjust the metal parts to the porcelain at the time of manufacture.

To overcome this difficulty this company desires to form a combination with some American company engaged in the manufacture of the metal parts of electrical wiring devices. Such metal parts to be manufactured in the United States and sent here for adjustment to the porcelain parts at this plant, or a factory to be established here in conjunction with the porcelain plant. The company here has excellent facilities for the manufacture of the porcelain parts of electrical wiring devices, and the plant is well situated geographically for the distribution of the products to European and South American markets, with quick deliveries.

Central-Station Rates in Theory and Practice

Outline of a Series of Articles on this Important Subject to Appear Weekly Throughout this Volume — H. E. Eisenmenger, Who Has Devoted Years of Research to Subject, Is Author

RATES for electric service are now to a large extent in a state of transition. Many central-station companies are being called upon to defend rates that were raised during the war and that are now being attacked because the war is virtually over. Other companies are being compelled to seek rate increases because there is no prospect of very material lowering of labor costs and costs of fuel and other supplies, so that the deficits involved in continuance of their present rates have threatened to wipe out previous surpluses or reserve funds and seriously impair net earnings.

Any rate revisions will very likely from now on be scrutinized with much more care than during the war when everyone recognized the emergency then existing and all new rates will be subject to severe scientific analysis and criticism. The whole subject of electric rates is therefore a very live one and should be given most careful study by central-station executives and all others interested in seeing fair rates established and maintained.

THE ELECTRICAL REVIEW has arranged for a very timely series of articles covering the entire subject of central-station rates in a very comprehensive manner and in such a way that will be found useful to every student of electric rates, *both the beginner and the expert*. These articles will cover about five or more pages of each weekly issue practically throughout the present volume, beginning next week, July 12, and probably ending Dec. 27, 1919. To suit the needs of various classes of readers, those portions dealing with elementary explanations for the beginners and those portions treating the technical features mathematically will be inserted in slightly different type, so that either of these portions can be passed over by the reader who does not care to or cannot follow these minor portions of the general text. The entire series of articles forms a connected whole, however, and besides being a comprehensive and original review of the entire subject includes much new matter which the author has developed.

A fairly good general idea of the scope of the entire series of articles can be obtained from the following:

GENERAL OUTLINE OF THE ARTICLES.

PART I—THE COST OF ELECTRIC SERVICE.

I. The Cost of Commodities in General.

A. THE COST OF A CERTAIN QUANTITY. TOTAL COST AND UNIT COST.

B. COST INCLUDING OR EXCLUDING CAPITAL EXPENSES.

C. SEGREGATE COST, INCREMENT COST AND AVERAGE COST.

D. BY-PRODUCTS.

E. PRODUCTS TO BE MEASURED IN MORE THAN ONE UNIT.

1. GENERAL EXPLANATION.
2. USING A SMALLER NUMBER OF ELEMENTS SIMPLIFIES THE COMPUTATION, BUT REDUCES THE ACCURACY.
3. USING A LARGER NUMBER OF ELEMENTS INCREASES THE ACCURACY, BUT COMPLICATES THE COMPUTATION.
4. INCREASING THE ACCURACY WITH A GIVEN NUMBER OF ELEMENTS BY SUBDIVIDING THE CUSTOMERS INTO CLASSES.

II. The Cost of Electric Service in Particular.

A. THE THREE ELEMENTS OF COST.

1. THE ENERGY COST.
2. THE DEMAND COST.
   - A. THE TOTAL DEMAND COST OF THE PLANT.
     1. *Capital Invested.*
     2. *The Constituents of the Demand Cost.*
        - a. Capital Charges.
          1. Net Returns (Interest, Dividend).
          2. Depreciation.
          3. Repayment.
          4. Other Capital Charges.
        - b. Demand Cost of the Plant Other than Capital Charges.
   - B. APPORTIONMENT OF THE DEMAND COST BETWEEN THE CUSTOMERS.
     1. *The Peak Responsibility.*
     2. *The Theoretically Exact Basis.*
        - a. Apportionment to Individual Customers, Considering the Shapes of Load Curves (Diversity-Factor).
     3. *Central Station's Peak Extending over a Certain Period of Time.*
     4. *The Consumer's Maximum Demand and Substitutes Therefor.*
     5. *The Diversity-Factor.*
     6. *Variations of the Demand Cost per Kilowatt Maximum Demand Between Customers.*
3. THE CONSUMER COST.
   - A. CAPITAL CHARGES.
   - B. OPERATING EXPENSES.
   - C. INFLUENCE OF THE CONSUMER COST ON THE TOTAL COST PER KILOWATT-HOUR.
   - D. VARIATIONS OF THE CONSUMER COST BETWEEN CONSUMERS.

B. DETERMINATION OF THE NUMERICAL VALUES OF THE THREE ELEMENTS OF COST.

PART II—THE PRICE OF ELECTRIC SERVICE.

I. General Remarks About the Three Principles of Establishing the Profit Over Cost.

II. The Principle of Charging What the Traffic Will Bear (Maximum Earnings).

III. The Value-of-Service Principle.

A. Advantages to the Public and to the Producers.

B. Factors Determining the Customer's Valuation of the Service.

C. Application to Individual Customers and Classes of Customers.

D. The Value-of-Service Principle in Central-Station Service.

1. General Principles.

2. Classification According to the Size of the Consumer.

A. THE SMALL CONSUMERS.

B. THE MEDIUM-SIZED CONSUMERS.

C. THE LARGE CONSUMERS. CENTRAL STATION VS. ISOLATED PLANT.

3. Classification According to the Purpose for Which Electricity Is Being Used.

PART III—SYSTEMS OF CHARGING.

I. General Features.

A. Reasons for Making Different Rates for Different Classes of Consumers.

B. Classification of Consumers for Rate Purposes in Practice.

C. Optional Rates.

D. Minimum Charge and Guaranteed Minima.

E. Maximum Unit Charges.

F. Prompt-Payment Discounts and Delayed-Payment Penalties.

II. The Various Types of Rates.

A. Introduction.

B. Rates Based on Energy Consumption Only.

1. The Straight Meter Rate.

2. Application of Lower Average Kilowatt-Hour Charges to Larger Energy Consumers.

A. REASONS FOR THE DESIRABILITY OF A GRADUATION OF THE KILOWATT-HOUR CHARGES

B. THE METHODS FOR APPLYING LOWER AVERAGE KILOWATT-HOUR PRICES FOR LARGER ENERGY CONSUMERS.

1. Limited Application of the Straight Meter Rate.

2. The Step Meter Rate.

3. The Block Meter Rate.

4. Combinations of Block Meter Rates with Step Meter Rates and Straight Meter Rates.

5. Explicit Customer Charge.

C. THE AVERAGE CHARGES PER KILOWATT-HOUR FOR VARIOUS CUSTOMERS

C. Rates Based on Demand Only.

1. Nomenclature.

2. Types of Service for Which Flat Demand Rates Are Used.

A. FLAT DEMAND RATES FOR DISPLAY LIGHTING, ETC.

B. FLAT DEMAND RATES FOR SMALL CUSTOMERS.

D. Rates Based on Both Energy Consumption and Demand.

1. Introduction.

2. Determination of the Demand.

B. THEORY AND GENERAL REMARKS.

B. DETAILS OF THE DETERMINATION OF THE MEASURED DEMAND IN PRACTICE.

1. Interval of Time Over Which the Customer's Demand Is to Be Averaged.

2. Period Over Which a Certain Amount of Demand, Once Determined, Remains the Basis of the Charges.

3. Sundry Details of the Determination of the Measured Demand.

a. Influence of the Demands of Previous Billing Periods.

b. Influence of the Power-Factor.

C. METHODS USED FOR MEASURING THE MAXIMUM DEMAND.

1. Determining the Demand by the Service Watt-hour Meter.

2. Demand Metering Instruments.

D. SUBSTITUTES TO APPROXIMATE THE MEASURED MAXIMUM DEMAND.

1. General Remarks.

2. The Various Substitutes for the Measured Demand.

a. Size of Transformer Required.

b. The Connected Load.

1. The Full Connected Load.

2. Percentage of the Full Connected Load.

c. The Number of Sockets or Outlets.

d. Encouragement of the Use of Domestic Appliances. Number of Rooms and Floor-Area Basis.

3. Description of the Various Rate Systems Based on Both Energy and Demand.

A. THE HOPKINSON RATE.

B. THE DOHERTY RATE.

C. THE WRIGHT DEMAND RATE (MULTIPLE RATE).

D. COMBINATION RATES.

PART IV—RATE ANALYSIS.

I. Arithmetical and Algebraic Rate Analysis.

II. Geometrical Rate Analysis.

PART V—ACCURACY OF RATES.

PART VI—PUBLIC UTILITIES AND PUBLIC REGULATION.

(By S. F. Walker)

I. Public Utilities and the Public Interest.

II. Regulation by Commission.

III. Procedure in Rate Cases.

The Author—H. E. Eisenmenger.

The author of the articles is H. E. Eisenmenger, who has devoted a great many years of research to the subject of central-station rates. For about 10

years he has acted as assistant to S. E. Doane, chief engineer of the National Lamp Works of General Electric Co., in his rate investigations and similar central-station questions, such as serving the small consumer, codes of wiring, etc. As an outcome of these investigations there was formed the Rate Research Committee of the National Electric Light Association. A few years before the war Mr. Eisenmenger was sent to Europe for a year by the National Lamp Works, during part of which time he was accompanied by Mr. Doane; he visited all of the European countries to study conditions as to electric service and especially what means were taken to reach small customers. The results of this study created a great deal of interest.

Mr. Eisenmenger has worked with several committees of the National Electric Light Association, especially those on Rate Research, Wiring of Existing Buildings, and Wiring Codes. He is the author of numerous articles and papers on rates and related subjects and the originator of two different methods of geometrical representation of rates, one of which was explained in a series of articles in the ELECTRICAL REVIEW AND WESTERN ELECTRICIAN several years ago. For practically a year he made a tour among the central stations of the Pacific Coast in an educational campaign on rate subjects. Prior to his work in this country he spent considerable time in Central Africa erecting a 3000-volt central station for the British Government, and a year in Japan on export business. He is therefore well versed on electrical conditions generally in many countries of four continents and a specialist on electric rates to which he has devoted so much study both here and abroad.

CIVIL SERVICE EXAMINATIONS FOR RADIO POSITIONS.

The U. S. Civil Service Commission announces examinations for the following vacancies in the Navy Department, Washington, D. C., and in the navy yard service: expert radio aid, radio inspector and subinspector, radio laboratorian and radio laboratorian aid. Competitors will not be required to report for examination at any place but applications properly executed must be filed prior to the hour of closing, July 8, 1919. Applicants should apply at once for Form 2118. Applicants will be rated on the following subjects which will have the relative weights indicated: Education, training, experience and fitness, 80; publications, reports or thesis, to be filed with application, 20. Ability to send and receive wireless in the Continental Morse Code is very desirable.

Applicants for expert radio aid, Grade 1, $7.04 per diem, must have graduated from a standard high school or completed a course of study equivalent to that required for such graduation, and must have had at least four years' experience in the design or manufacture of radio apparatus for the Government or for a contractor who has supplied satisfactory apparatus of this class to the Government. The successful completion of each year in a college or university of recognized standing, with major courses in electricity, will be accepted in lieu of six months of the required experience. For Grade 2, $10 per diem, applicants must have the high-school or equivalent education and seven years' of experience prescribed for Grade 1 of each year in a college or university of recognized standing, being accepted in lieu of nine months of such experience. Applicants for Grade 3, $12 per diem, must have graduated with a B. S. degree from a four years' course in a college or university of recognized standing, with major courses of study in electricity, and have had (a) six years' experience in actual responsible administration of the design and manufacture of radio apparatus for the Government or by a company which has supplied satisfactory radio apparatus of this class to the Government; or (b) for six years have conducted advanced research work and made valuable contributions to the science of radio, and be well known to the technical world as an investigator of ability; or (c) a combination of the experience prescribed under (a) and (b) totaling six years.

Applicants for radio inspector, Grade 1, $6 per diem, must have graduated from a standard high school or completed a course of study equivalent to that required for such graduation. In addition, they must have had at least one year's experience in installing radio apparatus in shore or ship stations or in repairing and maintaining such stations in service. The successful completion of each year in a college or university of recognized standing, with major courses in electricity, will be accepted in lieu of three months of the required experience. For Grade 2, $7.60 per diem, applicants must have the high-school or equivalent education and three years of the experience prescribed for Grade 1, each year in a college or university being acceptable as six months of such experience.

Applicants for radio subinspector grade 1, $2.80 per diem, must have successfully completed seven units (usual two years) of high school, and must possess a first-grade amateur license as radio telegrapher. For grade 2, $4.40 per diem, applicants must have the education specified for Grade 1, and, in addition, must possess a commercial radio telegrapher's license, or have possessed for at least two years a first-grade amateur license as radio telegrapher.

Applicants for radio laboratorian, Grade 1, $6.40 per diem, must have graduated from a standard high school or completed a course of study equivalent to that required for such graduation. In addition, they must have been actually engaged for at least two years in the design and manufacture of radio apparatus by the Government or for a contractor who has supplied satisfactory apparatus to the Government. The successful completion of each year in college or university of recognized standing, with major courses in electricity, will be accepted in lieu of three months of the required experience. For Grade 2, $8.80 per diem, applicants must have the high-school or equivalent education and four years of the experience prescribed for Grade 2; the successful completion of each year in a college or university of recognized standing, with major courses in electricity, being accepted in lieu of six months of the required experience.

Applicants for radio laboratorian aid, Grade 1, $3.20 per diem, must have graduated from a standard high school, or completed a course of study equivalent to that required for such graduation. In addition, they must possess a commercial radio telegrapher's license or have possessed for two years a first-grade amateur's radio license. For Grade 2, $4.80 per diem, applicants must have the high-school or equivalent education prescribed for Grade 1, and must have been actually engaged for at least one year in the design or manufacture of radio apparatus by the Government or by a contractor who has supplied satisfactory apparatus of this class to the Government. The successful completion of each year in college or university of recognized standing, with major courses in electricity, will be accepted in lieu of three months of the required experience.

Editorial Comment

A Million Homes Needed

REAL ESTATE men at the recent national convention in Atlantic City reported that there is now a deficiency of something like 1,000,000 homes in various sections of the country as compared with the housing facilities available before we entered the war. Building to supply this deficiency has begun, but it must be accelerated. Electrical men will be sadly remiss if they do not see that the houses and apartments being, and to be, built are properly wired and liberally equipped with sockets and receptacles for convenient use of lighting units and appliances.

Scientific Central-Station Rates

COMPARED with other electrical utilities, the rates of the leading central-station companies are probably the most scientifically and equitably developed. And yet there are many such companies, especially the smaller ones, who have much to learn in this line. The present time, when rates are so largely being revised, is especially appropriate to become acquainted with the latest information on this subject. We take pleasure, therefore, in calling the attention of our readers to the valuable series of articles on central-station rates outlined on other pages of this issue and which will be begun next week. Even experts cannot know too much on this often involved topic and will find much of interest in the articles that Mr. H. E. Eisenmenger has written for the benefit of all having to do with electric rates.

The Street Railways' Case

OVER 13% of the electric railway mileage of the country, principally street railways, is in the hands of receivers. This is a striking indication of the desperate situation confronting these railways. The percentage of bankrupt lines will continue to increase if relief is not soon afforded to the hard-pressed companies. The high labor and other operating charges of the last year or two show no prospect of diminishing; in fact, in some cities the men are seeking wage increases beyond those granted last year.

We have repeatedly urged in these columns that the utility regulating commissions be empowered to pass on wage controversies so that when wage increases are found necessary they can be granted and the income adjusted to provide for them through increased fares or other additional revenue or relief from certain other expenditures. Little has yet been done along this line, but the need for it is greater than ever. The War Labor Board, after raising the wages, recommended to the state utility commissions increase in fares to provide the needed income. The state commissions have been reluctant to act in many cases, however, because lacking authority to review wage scales. It is to be hoped that the Federal Commission now studying the matter will be able to offer a satisfactory and early solution.

Coal Costs Favor Electrically Operated Ice Plants

THE electrically operated ice plant has come in for much publicity and adoption during the last few years for many reasons that have been mentioned many times in these columns. One of the reasons why this type of ice-making and refrigerating plant should be expected to continue is that the cost of coal is high and has every indication of remaining high.

At a meeting of the American Society of Mechanical Engineers, held last December, it was stated that, on an average, there are far more plants requiring one ton of coal to every 1.5 to 2.5 tons of ice produced than there are plants producing 5 tons of ice per ton of coal, these statements applying to simple non-condensing plants. With coal at present prices, the cost of fuel per ton of ice has doubled and trebled in a brief period. Many steam-driven plants are now paying from $1.50 to $2.00 for fuel alone per ton of ice. And then there is the high cost of labor also to be taken into consideration.

Conditions are now extremely favorable to the electrically driven ice and refrigeration plant, and conditions show little indication of radically changing for considerable time to come. Now is the time to go after this load.

Making the Storage of Coal Safer

STORE your coal now, the slogan of a year ago, is still a good slogan today. It should be the slogan every year at this time, because this is the season when the storing of coal should be done, when the output of the mines needs to be maintained, when the railroads can best haul coal.

This year there are many special incentives to buy coal now. The Fuel Administration states a coal shortage will ensue this winter. The Secretary of Labor says a labor shortage impends. The Director General of Railroads predicts a car shortage. These things are all against the production and movement of coal; they are cumulative in inflating prices. Therefore buy your coal now.

However, the summer months are, unfortunately, the least favorable months for storing coal, at least

so far as the possibility of spontaneous combustion is concerned. But by following certain clearly defined policies trouble from internal heating of the coal pile can be greatly lessened and possibly eliminated. The safety of coal in storage depends partly upon the coal, but more perhaps upon the manner in which it is stored.

Avoid if possible storing coal that has the reputation of firing when stored. Store, preferably, 4-in. or 6-in. screenings, the portion passing through the screen to be used for current consumption. Keep the coal from one mine and seam together; from different mines separate. In choosing a pile site, avoid rough, hilly, soft, wet and boggy ground. Clear the ground of all vegetation, waste and dirt, and drain if it will not otherwise remain dry. Combustible material such as wood, rags and old clothes become hazards when buried under a coal pile. All sources of heat such as steam pipes, sewers, etc., have no place in proximity to a coal pile.

Coal fires spontaneously by the oxidation of fine coal particles presenting a maximum surface for the air to act upon. Coal, well screened and carefully piled seldom fires, because there is a minimum surface subject to oxidation. Store only approximately uniform coal sizes together because it is where the coarse and fine strata come together that a fire generally starts. Where this cannot be done adopt any of the several ways of watching the internal temperatures of the pile. When these things are done, spontaneous combustion in coal piles will lose most of its dread.

Is Not Co-operation the Solution to Today's Problems?

CO-OPERATION was the theme of Prof. C. A. Adams' presidential address before the A. I. E. E. convention at Lake Placid. In masterly style and with oratorical ability he touched upon many of the problems that are perplexing the world today. Into the problems of standardization, of labor, of capital and industry he brought the message of co-operation, harmony and understanding.

Every engineer should read and read again this presidential address. It is a challenge to some; it is a benediction to others and an inspiration to more. Engineers have been far too prone to consider themselves in the light of engineers, forgetting that they are citizens also. And no more valuable citizen should there be than the engineer with his training and his ability to utilize that training for his city, for his state and for his country.

Unquestionably the engineer can do much in developing solutions for many new vexatious economic, social and political problems. His approach of a problem without prejudices and his calm analysis of the conditions before attempting to pick out the remedy makes his final solution the most logical as well as most practical.

"May we not as engineers utilize our training and experience, our method of thought of which we are so proud, to encourage clean, straight, unbiased and fair-minded thinking, and to encourage that broad, generous co-operative spirit which will mean so much in breaking down the barriers which separate classes within a nation, as well as the nations themselves, and which is essential to the solution of the world problem which is knocking so hard at our door?"

The above, quoted from President Adams' presidential address, asks squarely and tersely what engineers are going to do in solving the pressing world problems of today. What, indeed, are we doing to give the engineer the place in the world that he deserves, that the world needs that he assume now?

Transmission-Line Relay Protection

RELAY protection has assumed very great importance of recent years. And the indications are that it will become even more important as time goes on. Today, many high-voltage transmission systems might more properly be called distributing systems. Systems are linked together, industrial substations and utility switching stations and substations are tied-in together in ring and radial systems so as to form a complete and complicated network in which each is an integral part of the whole.

Present-day standards require continuity of service to a very high degree. The growing complexity of networks, the vaster terraine covered, the greater magnitude of energy transmitted and interchanged between ever-growing loads makes relay protection against short-circuits and reversal of power and the segregation of power cessation vitally important and at the same time very difficult to obtain.

That this matter of relay protection is a pressing one is emphasized by the fact that a considerable portion of the program of the A. I. E. E. convention at Lake Placid was devoted to relay protection and allied subjects. For many years some of the largest transmission companies have been quietly and painstakingly tackling this problem of confining trouble where it occurs, segregating sections of line and substations in trouble and in other allied ways aiming to attain the goal of service continuity. Relay and protection engineering has thus become a recognized phase of central-station technique among those larger companies that tie in steel mills, electric furnaces, industrial plants and many more such loads with their ring and radial systems of high-voltage distributing systems.

Elsewhere appears an abstract of the very able report by Messrs. Roper, Woodrow, Traver and MacGahan on "Transmission-Line Relay Protection." This is an analysis of the protective relay situation throughout the country, and should thus be found enlightening to those that have already studied the matter seriously, and prove an inspiration to those whose systems are only now beginning to feel the need

for something better than a hit-or-miss mode of protection.

Relay protection against short-circuits is not only a matter of protecting apparatus. More important still, perhaps, is its function of maintaining continuity of service. Cheap power is important. But central-station service is judged today, not by cost but by quality. Continuity of service is, therefore, vital. Relay protection has done much and will yet do more to make continuity of service and central station synonymous terms.

Popularizing the Convenience Service Outlet

ELSEWHERE in this issue, a definite, practical plan to promote the installation of baseboard and wall outlets, which has been introduced by Mr. John G. Learned, chairman of Commercial Section, N. E. L. A., is described. For many years the electrical industry as a whole has recognized the need for the more adequate installation of such outlets but until now no real workable plan has been evolved therefor.

The value of such outlets is now apparent to every electrical man for they affect every branch of the industry—manufacturer, contractor and dealer, central station, jobber and the electrical inspector. Of these, the latter is the only one that has hitherto given the problem any consideration and it is only fair to say that he deserves the thanks of the industry for not having adopted some arbitrary means of combating this difficulty before.

However, Mr. Learned's plan in itself is a worthy one and deserving of the fullest support and co-operation of all parties concerned. The plan as laid out provides for an educational campaign to create a demand for these outlets from the public. The first part of this campaign is to be carried out by the manufacturers of electrical appliances who in their advertising and displays will show their devices connected to a wall, floor or baseboard receptacle. This will impress the public with the convenience of such outlets and naturally create a demand for them. The rest is up to the contractors, dealers and central stations. If these interests will get behind the idea and through their efforts and example try to "put it across," one of the greatest barriers to the use of electric power and appliances in the home will be removed and the results will surely prove worth while.

Spread of Estimators' Organization

BEGINNING with the organization of the Chicago Electrical Estimators' Association about a year and a half ago, the idea of forming associations composed of electrical estimators has grown steadily until at present there are at least five such organizations composed only of estimators and several more that, although they include others in their membership, are making a study of estimating problems. These associations have already accomplished a great deal toward standardizing electrical construction and in addition have brought forth considerable data which should stabilize the contracting business. For the estimator is the heart of the contractor's business and upon his work and ability often depends the contractor's success or failure.

However, there is still a considerable amount of work to be done along these lines, which can best be undertaken by such associations, much of which is dependent upon local conditions and can therefore be accomplished more readily by local organizations. For this reason not only the contractors but the jobbers, central stations and manufacturers should encourage and foster such organizations where they exist and endeavor to have others formed wherever possible.

The Forty-four Hour Week

ORGANIZED labor throughout the world is tending toward better working conditions and shorter working houhs. Last week the American Federation of Labor went on record unanimously as advocating a 44-hour week. It went further, by forecasting a five-day week to take care of unemployment. British unions have already adopted a 44-hour week in some cases; although let it be said the workers are now finding it a two-edged sword.

The shorter day for the same pay is not the same in result as higher wages; the latter stimulates efficiency and increases production. Shorter hours for the same pay almost invariably means higher production costs and lower production. This will tend toward higher prices unless the employer can obtain more output per employe per hour to offset the shorter working hours. In some cases this cannot be done without forcing the men to work more intensively. In many cases it can easily be done, however, without driving anyone harder. This has been shown by the greater and greater use of machinery in almost all industries. Machinery and the use of more scientific and efficient production methods is permitting more output to be obtained during the present customary 48-hour week than during the former 60 or 64-hour week. We have by no means reached the climax in the use of automatic and labor-saving machinery.

It is impossible to foretell just what will be the effect of a shorter working day. It certainly will necessitate the adoption of more efficient methods in industry and more intensive employment of machinery, electrically driven. In industries, such as the steel mills and foundries, it may mean higher load-factors, because of the necessity of maintaining double shifts in many cases. In fact, the need for increased efficiency and production will in many industries compel working three shifts throughout the 24 hours per day.

Workmen in former days used to combat the use of machinery. Nowadays they recognize that through machinery their hours of work have steadily grown less and their condition as steadily has improved.

Current Events

Engineering Society Celebrates Fiftieth Anniversary—Central-Station Men Convene—Ruling on Competitive Service

WESTERN SOCIETY OF ENGINEERS CELEBRATES FIFTIETH ANNIVERSARY.

Review of the Society's Growth and of the Engineering Developments of Fifty Years.

On June 27 the Western Society of Engineers celebrated its fiftieth anniversary. Two meetings were held on that day in the rooms of the society at Chicago, the first one being in the afternoon, at which the Past-President H. J. Burt presided in the absence of President Baldwin, who was called out of the city. Secretary E. S. Nethercut read a paper reviewing the history of the organization, which was formed May 25, 1869, as the Civil Engineers' Club of the Northwest. It was the third engineering society formed in the United States, the two preceding ones being the Boston Society of Civil Engineers, organized in 1847, and the American Society of Civil Engineers, organized in 1852. At the present time there are 15 national engineering societies, beside a great many state and local organizations.

Only two of the original charter members of the Engineers' Club of the Northwest survive. The first president was Roswell B. Mason, then mayor of the city. In June, 1880, the club was reorganized and its name changed to the Western Society of Engineers. In 1908 the present quarters in the Monadnock Block were enlarged and have become the chief engineering headquarters in the Chicago district. Up to 1909 the membership of the society was practically doubled each 10 years, but since then its growth has been much slower because the national societies at that time began the establishment of local sections. The Chicago sections of these societies hold meetings jointly with the Western Society of Engineers very frequently and in its rooms.

Many notable papers have been presented before the society, among these being several dealing with the investigations in aerial flight by Octave Chanute, a former president of the society. The society's code of ethics has a number of unique features. A standard of length was set up in the City Hall of Chicago through the influence of the society. The latter also took a prominent part in the passage of a law licensing structural engineers. Mr. Nethercut in conclusion pointed out the possibilities for the society becoming in a still larger sense the headquarters for engineering organization activities in the district tributary to Chicago, in which there are some 5000 members of various engineering societies, a large part of whom should have membership connection with the organization.

Samuel O. Dunn, editor of the *Railway Age*, reviewed the developments of 50 years in railroad engineering. The railroad engineers of this country have had an entirely different task from those abroad, because they had to build lines to develop the country, instead of merely furnishing transportation in sections already developed. In 1869 the first transcontinental line was opened and from then on up to 1895 there occurred an enormous building of railroad lines, especially in the West. Since that time the development has been more in the way of intensifying traffic and facilities along lines already built. As an instance of the growth in train weights, Mr. Dunn cited that when the Interstate Commerce Commission was established freight trains averaged about 175 tons, whereas now they average about 700 tons. A similar increase in length and weight of passenger trains has occurred. Railroad development now is at a crisis because of high labor and material costs, which call for more efficient utilization of each. The question of returning the lines to private ownership is a very difficult one. Although Mr. Dunn has some misgivings regarding the future of railroad development, he feels that the public will not let the lines suffer and thereby impair the commercial and industrial progress of the country.

James R. Bibbins gave a review of the developments in steam and power engineering, which he said were especially noteworthy since the beginning of this century. From very small sizes steam turbines have grown to extraordinary capacities. Boiler units also developed from 250 hp. to duplex units of 3000 hp. rating, with enormous and very efficient combustion chambers and a stoker at each end. Extreme care has been given to study and design of the parts of steam turbines, to the utilization of higher pressures and superheats and to the use of higher speeds. The outcome has been the gradual development of the very large units of today. At the same time important developments have taken place in the way of generators and other rotating electrical machinery and other power plant auxiliaries. Much of this has been made possible through the developments in the metallurgical line, which have permitted the imposing of much more severe strains upon metals and alloys. Together with the growth in capacity has been an extraordinary advance in efficiency in every step of the process of power production from the coal pile to the busbars. In the case of the largest turbo units the thermodynamic efficiency at the best load now is nearly 25%, which has given the internal-combustion engine a very close race. Improvement in reliability has also taken place, as for instance improved condenser practice has practically eliminated air troubles and the water that leaves the condenser is practically the same temperature as the entering steam. Organization of power plants has also been highly developed. Remote control is now largely used because of its simplicity and directness at the command of the load dispatcher. Many automatic protective devices, indicating and recording instruments are now employed, so that the operation has been highly perfected. As the result of the increase in size of units the installation cost has been decreased from something from $150 per kw. to about $70. At the same time the over-all commercial efficiency has been very greatly raised.

J. R. Cravath gave a review of the developments in electric lighting and power applications, all of which

took place within 50 years. During the 70's the electric motor was developed and a few years later the arc lamp, followed in the early 80's by the introduction of incandescent lamps, and in the later 80's by the use of motors for electric railways. The alternating-current developments began in the early 90's and soon resulted in the growth of power distribution systems or networks, which have become very extensive especially since the beginning of the present century. Machine drive is now almost entirely electrical, whether power is derived from the central station or an isolated plant. Electric lighting developments have been very rapid and now electricity has replaced almost everything else in the illuminating line, even on the farm. Especially in lamp and lighting development the result of research has been of untold value.

Frank F. Fowle gave a review of developments in electrical communication, especially in telephony. He reviewed the development of the telephone from the inventions of Dr. Bell and the gradual growth that took place during the life of the original basic patents. After these expired great stimulus was given to the industry, many independent manufacturing and operating companies entering the field soon after 1895; now there are about 13,000,000 telephone stations in the United States. During the late 80's took place the development of simultaneous telephony and telegraphy on the same wires; later the introduction of Pupin loading coils extended long-distance telephone service. The use of repeating coils aided this further and during the last few years the use of the vacuum type of repeater, based on the audion, has given telephony wonderful possibilities. The automatic telephone was first developed by the independent telephone interests. The war has aggravated the operating troubles of all telephone companies, due to higher wages and scarcity of operators, so that the automatic telephone is undoubtedly going to be put into quite extensive service, as soon as the companies can provide the necessary heavy financial investment required. A change is now coming about through gradual abandoning of the open overhead wire lines and converting them to cable lines, either overhead or underground; the use of the audion repeater has made this commercially possible and this will make for great increased reliability of service during storms. The audion has also made possible the use of multiplex telephony.

John W. Alvord gave a review of sanitary engineering, showing that from 90 to 95% of what we call modern sanitation has been developed within 50 years. Since in the early 80's, when the study of bacterial origin of disease began, water and food supplies have been very materially purified. The filtering of water supplies is now carried out very extensively. Water works systems have become common only since about 1880. The treatment of sewage and other wastes, as well as the purification of water supplies has helped increase the average human life from 23 years at the close of the 18th century until about 40 years in 1900. Typhoid fever is no longer a serious menace. Whereas 20 years ago it was common to have 20 to 120 deaths per 100,000 persons annually from this cause, now this seldom exceeds 5 deaths for the same number.

After dinner at the Chicago Engineers' Club, an evening session was held in the rooms of the society at which Col. Henry A. Allen of the 108th Engineer Regiment was the principal speaker. He gave a general summary of the history of this regiment, which was originally the First Regiment of Engineers, Illinois National Guard. Soon after the outbreak of the war it was increased in strength, trained at Camp Logan and sent to France. Colonel Allen gave an interesting account of the various experiences of the regiment in building all kinds of structures for the expeditionary forces, as well as bridges and other military works close to and frequently in advance of the firing line. He spoke very emphatically in favor of thorough preparedness and much longer training than was possible during the recent war. A soldier should have at least two years of training and an officer from 4 to 6 years. To rush insufficiently trained troops into service under insufficiently trained officers is practically committing murder, because of the absolutely unnecessary sacrifice of the men involved thereby. He also emphasized the need of thorough equipment.

The remainder of the evening was devoted to addresses by past presidents of the society. The society has had 41 presidents, of whom 17 have died. Of the remaining, 12 were present at the meeting. Addresses were made by Past-Presidents S. G. Artingstall, Isham Randolph, John F. Wallace, Ralph Modjeski, William L. Abbott, C. F. Loweth, Andrews Allen, John W. Alvord, Albert Reichmann, H. J. Burt and Charles B. Burdick. Most of these addresses were of a reminiscent character and several of the late past-presidents pointed out the opportunity for the society as the engineering headquarters for Chicago. Communications were also read from Past-Presidents W. B. Jackson, W. C. Armstrong, B. E. Grant, R. W. Hunt and E. H. Lee, and from a former secretary, J. W. Weston, and Mr. Blunt, one of the charter members.

Saturday, June 28, was devoted to an all-day outing at the Dunes, a very interesting geological sand formation with a great variety of botanical specimens at the southern end of Lake Michigan in Indiana.

INDEPENDENT TELEPHONE MEN DISCUSS THEIR PROBLEMS IN CONVENTION.

Annual Gathering of United States Independent Telephone Association Held in Chicago June 24-26.

A very well attended annual convention of the United States Independent Telephone Association was held at the Hotel La Salle, Chicago, on June 24 to 26. inclusive. The 900 odd delegates and guests were welcomed to Chicago by E. T. Stevens, of the Chicago Association of Commerce, and O. F. Berry replied for the association. In his annual address President G. W. Robinson, St. Paul, reviewed the principal features of the association's work and its importance to the industry. He referred to the taking over of the telephone lines by the Government last year and said that, on the whole, the companies had benefited thereby.

Secretary-Treasurer W. S. Vivian, who recently returned from service in France, in presenting his annual report made many valuable suggestions on how the association could develop and increase its service to its member companies. He urged employment of practical specialists in several branches of telephone work. A committee was appointed to consider means for putting Mr. Vivian's ideas into effect. L. E. Hurtz, of Lincoln, Neb., narrated his experiences in Washington, D. C., assisting F. B. MacKinnon in representing the independent companies before congressional committees and various executive branches of the Government, especially since the Government took over the lines.

At the Wednesday session the election of ten members of the board of directors was effected, after which

Capt. Terry W. Allen, of Jackson, Tenn., spoke of the strenuous work of the Signal Corps in France. B. J. Mullaney, Chicago, described the publicity campaign of the Illinois Committee on Public Information. Samuel Insull, president Commonwealth Edison Co., spoke on "The Present Position of Public Utilities," as reported in our last issue.

A luncheon session was then held at which H. F. Atwood spoke on "Our Constitution—an Antidote to Bolshevism." F. B. MacKinnon, vice-president of the association and for many years its representative at Washington, D. C., spoke at length on the work accomplished at the capital. He reviewed in detail the steps taken when and since the Government took over the lines and interpreted many orders of the Postmaster-General and also his general policy.

During the afternoon the board of directors held a meeting at which F. B. MacKinnon was elected president of the association for the ensuing year; Frank L. Beam, J. B. Earle and W. F. Goodrich were elected first, second and third vice-presidents, respectively. President-elect MacKinnon presided at the concluding session on Thursday. O. A. Knell, St. Paul, Minn., presented a paper on "Choosing Employes by Test." Dr. F. A. Wolff, of the Bureau of Standards, led a discussion on telephonic standardization, in which A. B. Smith, H. D. Currier, and R. H. Manson participated. Miss M. Martin spoke of the work of the girls with the Signal Corps in France. After addresses were made by several other incoming officers and resolutions were adopted approving the rate changes made by the Postmaster-General, the convention adjourned.

IOWA SECTION, N. E. L. A., HOLDS INTERESTING MEETING.

Features of Public Utility Management Brought Out at Annual Convention at Colfax.

Public utility management was the principal topic of discussion at the annual convention of the Iowa Section, N. E. L. A., held on June 18, 19 and 20, in Colfax, Iowa. According to the preliminary announcements sent out, this convention offered an opportunity to get a four-year course in this subject in three days and from the variety of excellent papers presented, together with the lively discussion that followed, it is evident that this contention was true.

In his opening address, President Bellamy made several valuable suggestions intended to further the activities of the section and broaden its scope and pointed out the difficulties being encountered by many companies due to the higher costs of labor and materials. These advances, he explained, would not be overcome by operating economies and it was therefore necessary to increase the rates in many cities.

William Chamberlain, general counsel of the United Light & Railways Co., Cedar Rapids, Iowa, then addressed the members on "Rate Litigation in Iowa," in which he described the difficulties encountered by many utilities in securing necessary rate increases. Following Mr. Chamberlain, Dean William G. Raymond, of the State University of Iowa, explained the work of the Board of Conciliation which rendered valuable assistance to the utilities during the war but, being purely a war-time measure, will be dissolved shortly. Other papers presented during the meeting which dealt with the subject of rates were: "Rates as Affected by the Increased Cost of Production and the Attitude of Regulatory Bodies Thereto," by X. A. Warfield, Illinois Traction System, Peoria, Ill., and "Principals to Be Observed in Determining a Rate for Electric Service in Cities Under 5000," by Prof. J. B. Hill, of Iowa State University. At the conclusion of Professor Hill's address a lively discussion ensued which brought out very clearly the value of having a uniform method of determining rates for service in the various localities in the state. W. A. Jones, of the Empire District Electric Co., Joplin, Mo., explained the accounting system recommended by the Accounting Section of the N. E. L. A. for use in small plants. Prof. F. O. Paine, of Iowa State College, told of the four-day course in meter testing for the employes of small plants which was conducted during the past winter and described the many valuable results which had been obtained.

The principal addresses at the banquet were delivered by John F. Gilchrist and E. W. Lloyd, both of the Commonwealth Edison Co., Chicago. Mr. Gilchrist's address dealt with public relationship and the advantages of securing the good will of the public. Mr. Lloyd described the work which is to be carried on by the national association during the coming year and its effect on the local section activities.

Several interesting and instructive papers relative to farm services were also presented, the principal one being "The Electric Transmission Line and Telephone Interference Situation in Iowa With Respect to Farm Line Service," by H. S. Phelps, electrical engineer, Iowa Railroad Commission. From the discussion it is evident that the companies realize the necessity of devising some means of serving the farmer for the demand for such service has grown tremendously in the past few years. Several other addresses were also made which dealt principally with municipal ownership and socialism.

The meeting closed with the election of officers for the coming year which resulted as follows: President, O. H. Simonds, Dubuque; vice-president, J. P. Ingle, Keokuk; secretary-treasurer, M. G. Lind, Des Moines. The following directors were also chosen: Austin Burt, Waterloo; B. G. Schmidt, Elkrader; Paul Myers, Grinnell; John Drabelle, Cedar Rapids; C. E. Burke, Sioux City; F. J. Hanlon, Mason City; Charles Miller, Claremont; C. G. Johnson, Davenport; C. E. Farney, Ottumwa, and F. W. Brooks, Omaha.

NEBRASKA CENTRAL-STATION MEN HOLD ANNUAL CONVENTION.

Probable Effect of Coming State Constitutional Convention on Utilities Principal Topic of Discussion.

The Nebraska Section of the National Electric Light Association held its annual convention at Grand Island, Neb., June 18 and 19. The meeting this year proved to be exceptionally interesting, for in addition to the usual technical discussions, several interesting addresses on public relationship were presented.

J. E. Davidson, of the Nebraska Power Co., Omaha, president of the section, presided during the meeting and also delivered a very interesting address in which he reviewed the effects of the war-time conditions on Nebraska central stations and explained that the efforts to meet these conditions which will undoubtedly prevail for some time to come, should be continued. He also pointed out the need of co-operation among the members in order to secure the proper support of the state authorities which would enable the companies to overcome these conditions.

Charles Kelsey, of Norfolk, Neb., described the probable effect of the coming constitutional convention

on public utility companies. This convention has been called to remodel the present state constitution and will undoubtedly incorporate in the new constitution some measures affecting the utility companies. The exact nature of these measures cannot be determined as yet, but the utilities should exert every effort to secure proper legislation. At present, the only work that can be done is to educate the public to the utilities' problems and thus secure their co-operation.

Another interesting paper entitled "The Man in the Street" was read by R. J. Andrus, Grand Island, Neb. In this paper, which was written by S. M. Kennedy, of the Southern California Edison Co., Los Angeles, Cal., the necessity of securing the co-operation of the general public and the methods to be followed in accomplishing it were clearly brought out. J. M. Smith, of Omaha, presented a paper on the "Sale of Utility Securities to the Public" in which he pointed out the value to the utility of taking the consumer into partnership by making him a shareholder. In addition the "Attitude of the Public Toward Utility Companies" was described by F. E. Helvey, of Lincoln, Neb.

The work which is being done on the National Electrical Safety Code was described by Mr. Sahm of the Bureau of Standards, Washington, D. C. In addition the following papers were also presented: "New Business," by W. S. Byrne, of Omaha, Neb.; "Modern Steam Central-Station Practice," by H. A. Lynette, Chicago, and "Safety Measures and Accident Prevention," by C. B. Scott, of Chicago.

The following officers were elected: T. H. Fritts, Central Power Co., Grand Island, Neb., president; James B. Harvey, Nebraska Power Co., Omaha, vice-president. J. E. Shuff of the Lincoln Gas & Electric Co., Lincoln, Neb., is at present secretary, but arrangements are being made to provide for a paid appointee to this position.

At the close of the meeting an inspection trip was made to the new hydroelectric station of the Central Power Co., at Boelus, Neb.

PENNSYLVANIA SUPREME COURT MAKES IMPORTANT RULING ON COMPETITIVE UTILITY SERVICE.

The State Supreme Court, Pennsylvania, has handed down a decision in connection with the application of the Perry County Telephone & Telegraph Co., Landisburg, Pa., to the Public Service Commission for permission to construct a new line between New Bloomfield and Newport. The Court upholds the Commission in its refusal to permit the company to construct the line; the Commission held that the present service to these communities, as rendered by the Perry County company and the Cumberland Valley Telephone Co., was fully adequate. In this the Commission maintained that the construction of the line under the circumstances would double the capital charge upon which the public would pay and would also divide the service between two companies so that the same public would be required to rent two telephones in place of one in order to reach all local users.

In sustaining this view, the Supreme Court establishes important precedents as regards so-called ruinous competition by public utilities and says, in part:

"Competition may be and is very desirable in many lines of business; there are, however, a number of quasi-public enterprises which may be classified as natural monopolies in case the duplication of facilities merely results in the placing of an additional burden upon the public by forcing persons to maintain two systems where one would serve the purpose as effectually and at less cost. In this class may be placed the furnishing of gas, water, electricity and telephone service to the public. The argument that competition between rival facilities serves to reduce the price to the consumer is not sustainable logically.

"The duplication of telephone systems, for instance, in a given locality without connection between their lines requires subscribers to install both systems and pay double service to reach subscribers on but one of the two systems. Or, as frequently happens, subscribers maintain both systems when they can reach other users with equal facility on either system.

"It is useless to argue that the cost of construction of such duplicate systems is paid by investors and the risk of financial failure is theirs, because to the burden of finally paying the carrying charges, and income to the investors is imposed upon the public with the result that a higher charge on the part of each competing company becomes necessary, due to the division of the patronage of the public. This is especially true in the smaller cities and country districts where the public to be served is limited in numbers. To hold, therefore, that public policy, as indicated by the section of the constitution in question, was intended to permit the construction of competing lines under any and all conditions without inquiry into the character of the territory to be served and the existence in the locality of facilities adequate to accommodate the public, would amount to a destruction of the very object the policy is designed to establish."

ELECTRIFICATION OF RAILWAY IN BRAZIL.

A director of the Central of Brazil Railway, Government owned and operated, has presented to the Minister of Communications plans for the electrification of the suburban lines of the road and the trunk line from Barra to Pirahy, as well as general plans for the suburban service and the closing of the roadbed from the main station to Deodoro.

The Commission chose high-tension, direct current for the suburban service, and recommended that the current be purchased from one of the existing power companies rather than have the company install a plant of its own.

The approximate cost of the rolling stock, substations, aerial lines, etc., is estimated at $4,307,377. This does not include the cost of car sheds at the main station and at Deodoro.

The first work to be undertaken will be fencing in and raising the level of the track in order to avoid accidents. It is believed that by closing in the lines the revenues of the suburban service will be greatly increased, as such a step will facilitate a better fiscalization of the passenger receipts. This work will probably cost about $1,398,238, the estimate being based on the prevailing prices of materials.

The director added that in case the total amount required for this work was not available during the present fiscal year, it would at least be well to begin the work of closing the line, as a half million dollars was appropriated for this purpose in the budget law for this year.

Upon receipt of the plans, the Minister of Communications approved them and directed that the work of closing in the line from the central station to Deodoro be initiated.

Commercial Practice

Vigorous House-Wiring Campaign — Live Window Displays—Truck Fleet Large Power User—Message by Movie

DUQUESNE LIGHT CO. PUSHING VIGOROUS HOUSE-WIRING CAMPAIGN.

Aims to Wire Five Thousand Houses by the End of the Year.

The Duquesne Light Co. is pushing a vigorous house-wiring campaign, that is a very ambitious one. Special effort is being made to wire old houses, and the high mark or goal the company is after is 5000 such houses in the Allegheny and Beaver Counties of Pennsylvania. A new reduced electric light rate goes into effect on July 1, and this, coupled with the campaign and healthy conditions, leads the company to look for the most prosperous year in its history so far as concerns the wiring of houses and obtaining the residential load.

The greatest year in the company's wiring history was in 1917, when 2612 houses were wired. During the first five months of that year 940 old houses for wiring were secured. During the first five months of this year the company actually closed 1804 contracts for wiring old houses in Allegheny County alone, as compared with 1829 for the whole of 1918. In Beaver County, 270 contracts have been closed, as compared with 200 during the whole of 1918. This means that for the first five months of this year a total of 2074 old house-wiring contracts have been obtained, whereas the total for the entire year of 1918 reached 2029. It is in face of these facts that the company faces with enthusiasm and faith the campaign which carries with it the slogan, "5000 Wiring Contracts by Jan. 1, 1920."

LIVE SHOW-WINDOW DISPLAYS BRING MANY SALES.

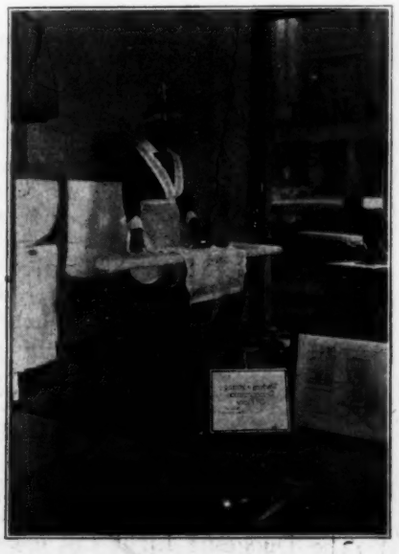
New York Edison Co. Finds Window Demonstrations of Labor-Saving Devices to Have Great Drawing Power.

An elaborate system of window demonstrations of electric labor-saving devices for the home has been instituted by the Showroom Committee of the New York Edison Co., New York City, and is producing most satisfactory results in increasing the sales of household appliances. This window-display work was begun last December simply to catch the attention of the Christmas shopping crowds that pass along Forty-second street, that busy up-town thoroughfare where the Edison company has a branch office. The demonstrations, however, were so successful that they have been extended to seven of the company's showrooms and recently, by special arrangement, to the showroom of the Yonkers Electric Light Co., Yonkers, N. Y.

For each week a different subject is selected. Thus, the first week might be washing and ironing; the second, cooking on small electric appliances; the third, sewing by motor-driven machine; and the fourth, vacuum cleaning. The windows are arranged to represent home conditions as much as possible and to give reality; real work is done, not merely the lifeless doing the same thing over again, which is the bane of most window demonstrating. Blankets and small rugs are washed in the laundry machines, features which have scored among the women in the crowds gathered to watch. When cooking is done in the window, the women outside are invited to step in and

Electric Sewing Machine, Operated by a Uniformed Attendant, Proves Excellent Show-Window Attraction in New York Edison Co.'s 42nd Street Showroom.

Electric Dish-Washing Exhibit Ready to Go Into Display Window—Where Customers Cannot Afford to Purchase a Dish-Washing Machine, Electric Fans Are Recommended for Drying.



The Electric Ironing Window Demonstration Produces More Orders Than Any Other—After a Week in the Window This Exhibit Was Used in the Showrooms and Still Brought Sales.

sample the food, to convince them that it does taste as good as it looks. When vacuum cleaners are demonstrated, not only rugs are cleaned, but clothes, curtains, cushions and sofa pillows, to suggest the wide usefulness of a cleaner in an actual home.

Although these extensive demonstrations were intended originally for the crowds along Forty-second street only, when the showroom orders began assuming a marked ascent, other of the larger offices requested demonstrations. Then experimentally, a vacuum cleaner exhibit was made for a few days in the window of one of the smaller offices, in a location supposedly not favorable to this method. Within a few days, ten cleaners were sold there; needless to say, it was arranged to continue demonstrations in this supposedly "unproductive" territory. With the smaller offices, however, the best results are obtained by having demonstrations on alternate weeks, so as not to exhaust local interest. As an added attraction for the summer, window demonstrations of drying and preserving fruits and vegetables will be made, using electric fans for drying and an electric fireless cooker for canning.

A rather surprising item of this campaign has been the extraordinary success of an ironing exhibit arranged at first simply as a background for a window demonstration of washing and ironing. Behind the window was arranged a large table filled with flatirons of every type and make, and nearby stood a demonstrator, who ironed all day long without apparent effort or fatigue. During the first week of this exhibit, orders were taken for a daily average of 14 irons, and the showroom force requested its continuance until the sales fell away. That was two months ago, and the pulling-power of the exhibit has remained almost undiminished. At a conservative estimate, nearly $2500 worth of orders have been taken at a cost of between 5 and 6% of the amount represented.

These demonstrations also follow out the well-known policy of the New York Edison Co., as determined by Arthur Williams, general commercial manager, to have Edison showrooms take orders for manufacturers, but not to have the company go into the selling business on its own account. Customers attracted by the demonstrations go into the showrooms where they see appliances representing the products of the best known manufacturers, who in this way, profit as well by the advertising value of the "live" windows. On the other hand, the Edison company believes that it gains more than the actual new business as the demonstrations tend to increase the usage of apparatus already on the lines, when people in passing the windows see some of the less common applications of the devices illustrated by the demonstrators. Although not so spectacular as the widely advertised and elaborately conducted flatiron or cleaner "week" usually advocated, the net results of this new form of sales-pushing indicate that it is more satisfactory for a city of the size of New York.

ELECTRIC TRUCK FLEET GOOD CONSUMER OF ENERGY.

Fleet of Thirty Trucks Uses Nearly 11,000 Kw-hr. Each Month.

The Duquesne Light Co. operates a fleet of 30 electric trucks in Pittsburgh in connection with its business. These trucks are giving a good account of themselves as to work, while proving economical as to operation.

The average energy consumption of these 30 electric trucks averages about 10,900 kw-hr. each month, or about 364 kw-hr. per truck per month. On the basis that the average family uses about 18 kw-hr. per month the year round, the energy consumed by this fleet of 30 trucks is about the same as would be consumed by 7266 houses during one month, or 605 houses for a whole year. This fact emphasizes the value of the electric truck as a load builder, it being borne in mind that the energy consumed by these vehicles is consumed at a time when the houses or residents would be using little if any.

THE ELECTRICAL MESSAGE TO MILLIONS VIA THE MOVIE ROUTE.

Society for Electrical Development Displays Seven Educational Films to Exporters.

On June 27 there was held a review of seven motion-picture electrical films prepared by the Society of Electrical Development and one by the Western Electric Co. This exhibit was unique in its inception and its execution.

Not long ago, Mrs. May Savell Croy, an expert on electrical house furnishings, installed a complete electrical kitchen and laundry in the beautiful new Bush Terminal Sales building at 130 West Forty-second street, New York. This is part of an "ideal cottage" in which the wonders of electricity are explained to visiting importers, exporters and buyers from all over the world.

Exporters who recently visited the Bush Sales building were interested in knowing that a film had been made the previous day at Mrs. Croy's exhibit and wanted to know where they could see it. The film, "Table Cookery," was developed by the Society for Electrical Development and the Universal Film Co. So, for the special benefit of the exporters and by courtesy of the Bush Terminal Co., an exhibit was arranged at which the Society's films and one of the Western Electric Co. were shown, and to which also were invited prominent men of the industry in New York, Brooklyn, New Jersey, and the members of the Society in the Metropolitan District. Also there were in attendance newspaper men, representatives of the trade press, and the women household editors of prominent magazines.

The Society's staff works with various film companies to offer electrical suggestions, correct errors and devise useful educational propaganda. The Society has prepared over a dozen special electrical moving-picture films, in conjunction with the Universal Film Co., and has worked with the Western Electric Co. and other manufacturers and jobbers to the same end.

DEVICE CAMPAIGNS FLOURISH IN ARKANSAS.

The commercial department of the Arkansas Valley Railway, Light & Power Co., Pueblo, Colo., is conducting a series of campaigns on electric household devices. A recent electric washing machine campaign resulted in the sale of 18 machines and prospects for many more. An electric vacuum cleaner campaign is now in progress and later another campaign will be opened on the small labor saving electric appliances. In a recent week local contractors secured in co-operation with the company's commercial department, orders for wiring 52 already-built houses.

Operating Practice

Reducing Flash-Overs of Converters — Generator Waterproofing — Relay Engineering — Identification of Piping

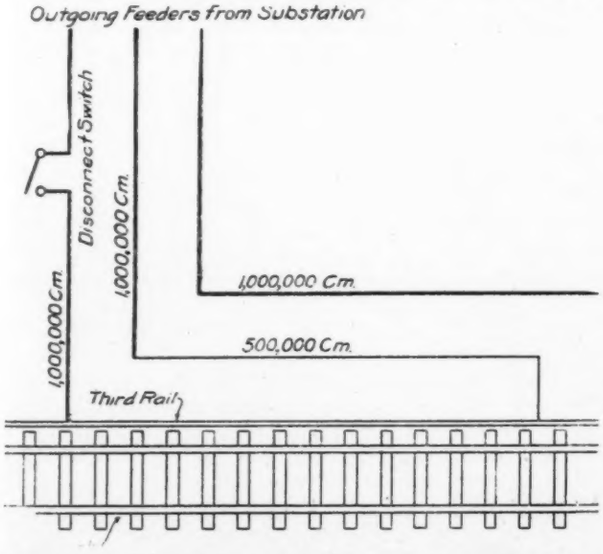
REDUCING CONVERTER SHUT-DOWNS BY CHANGING FEEDER LENGTHS.

Variable Feeder Lengths According to Loads Overcomes Trouble.

It has been the experience of companies supplying electric railroads with direct current that trouble is to be expected when the synchronous converters are located at heavy load centers where the loads are heavy and the feeders of short length. Such locations are those where a substation is located directly at a railroad terminus or freight yard. In these instances the third rail or trolley may be used as a feeder, and feeder lengths may be short. The result is that a heavy swing of current due to trouble on the railroad reacts directly back to the station bus.

One manner in which this trouble may be overcome is to increase the length of the feeders or insert resistance so as to increase the equivalent feeder length —that is, the resistance of the circuit. And then the introduction of resistance is not the same as the introduction of inductance, resistance being effective while current is passing through it, while inductance is effective only while the current value is changing. Obviously, therefore, the introduction of inductance is preferable to the insertion of resistance since it affects the circuit—the voltage regulation—only when actually needed, namely, on current change.

In one instance where a substation was located



Schematic Layout of Railway Feeders for Changing Equivalent Feeder Length With Load.

directly at a large electric terminal yard, the current rushes due to short circuits were very severe. When two synchronous converters were operating these short circuits only opened the feeder breaker, but when one machine was operating alone its breaker would open, shutting down the converter, and sometimes causing it to flash over. There were a number of heavy feeders going to the yard. Two of these were of 1,000,000 c.m. and about 300 ft. in length. One of these tapped directly to the third rail; the other connected to a 500,000-c.m. cable which tapped to the third rail some 1000 ft. away.

Flash-overs and the opening of the machine circuit-breakers occurred only when one synchronous converter was operating. The trouble was overcome in the following simple and inexpensive manner. In the substation basement, the 1,000,000-c.m. cable that connected directly to the third rail was cut open and connected to a disconnect switch of sufficient current-carrying capacity. During comparatively light load periods, when only one synchronous converter was used, this switch was opened by the operator and left open, the effect of which was to feed the third rail over the feeders having 1000 ft. of additional length. The result was that the low resistance of the 300 ft. of 1,000,000-c.m. conductor was eliminated, thereby reducing the current rush on short circuit, and yet without increasing seriously the voltage drop at the normal current of light load. When the load increases sufficiently to warrant operating two converters, the disconnect switch in the short 1,000,000-c.m. feeder is closed.

WATERPROOFING TURBOGENERATOR WINDINGS.

Generous Use of Varnish Lessens Objections to Use of Water.

Considerable publicity has been given of late to the matter of fireproofing turbogenerators and how best to fight internal fires when they do occur. Water, steam, carbon tetrachloride and carbon dioxide have been suggested, with water and steam in preference on the score of cost, availability and safety.

In using steam cognizance must be taken of its effect upon insulation and to what extent the heat and moisture will cause disintegration of cambric and varnishes. The insulation of turbogenerator windings may be divided into three classes, all-fibrous, composite and all-mica, and each of these will be affected differently by both water and steam.

All-fibrous insulation is now used only on the older machines, and is not waterproof in any sense of the word. Composite insulation is made up of mica tape, is treated in a vacuum and finished with layers of tape which is fibrous material. By careful and generous application of varnish this composite insulation can be made to approach if not attain a waterproof condition. All-mica insulation is waterproof, except where tape is applied on the job, and here also several good coats of varnish makes this type of insulation waterproof.

Little fear need, therefore, be apprehended in applying water to turbogenerators whose windings are insulated with all-mica or composite insulation. On the other hand it should be made a special point when overhauling and doing the periodic annual repairs to the older types of machines using fibrous insulation to pay special attention to applying generous coatings of varnish so as to seal up this form of insulation lest the time come when it may be necessary to fight an internal fire with water or steam.

CONSIDERATIONS AFFECTING OPERATION OF OVERLOAD RELAYS.

By A. E. Hester.

No set rules can be laid down to govern the application of relays. Each and every power system has its own peculiarities and the choosing and setting of relays must be governed by these. However, if a careful study is made of the system and the conditions existing on each section are thoroughly analyzed no great difficulty should be encountered in securing satisfactory protection on any power distribution system. The accuracy and permanence of calibration of the modern induction type relay insure satisfactory operation if proper application is made.

In laying out a protective scheme on any system a great many factors have to be taken into consideration. The characteristics of the line and each piece of apparatus, generating, switching, transforming and converting, should first be carefully studied as this is what determines the amount of short circuit current available. In determining this short circuit current it should always be considered as due to a solid metallic short circuit with minimum generating capacity.

One method of determining the possible short-circuit current is to observe the voltage drop between two stations at normal load, when the short circuit current is given by $\frac{\text{Normal voltage}}{\text{Voltage drop} \times \text{load}}$. This is only approximate however and is very likely to give high results.

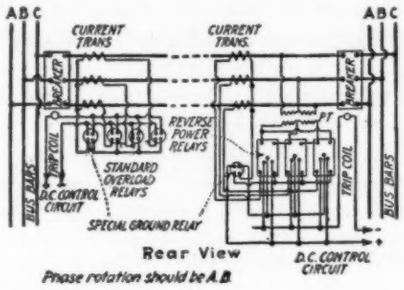
Another method is to determine the total impendance, including that of the generator between any point where the short circuit value is desired and the generator, then short circuit current $= \frac{\text{Star voltage}}{\text{Impedance}}$. This gives the instantaneous short circuit, however, and the sustained value is much less, usually about 2 or 25 times full load current.

Unless a special scheme is used for disconnecting a line on a high resistance ground, as would be necessary in the case of a generator having its neutral ground through a comparatively high resistance, modern relays will not clear a high-resistance short circuit. This is no disadvantage, however, as a high resistance short circuit will invariably develop into an arc before any damage is done and since an arc has a very low resistance the effect of a metallic short circuit will be obtained and the relays will operate.

The various connections and combinations used on a system also deserve careful attention when laying out a protective scheme. First the number and location of the power sources should be taken into consideration. The main thing to be considered is whether or not there is more than one source, since a layout which would be suitable for a system having one source of power might not be suitable for another having more than one source.

It sometimes happens that a system has its neutral grounded through a comparatively high resistance and when a ground occurs conditions may be such that the trouble current is actually less than the full load current. Such a ground cannot be cleared by reverse power and overload relays connected to protect the system against short circuits.

This difficulty may be overcome by using an overload relay, constructed to operate on low currents,



connected in the neutral lead of the current transformers as shown in the accompanying diagram. Then under normal conditions no current flows through the neutral lead of the current transformer bank. But as soon as the ground occurs the unbalanced current flows through this lead and the ground relay and the circuit breaker is opened.

When used with overload relays the ground relay contacts so that its operation opens the circuit breaker directly. When used with reverse power relays, however, the ground relay contacts are used to short circuit the contacts of the overload element of the reverse power relays thus leaving the watt elements to discriminate as to the direction of power flow. This is clearly shown in the diagram.

It is possible by carefully studying and analyzing the conditions to secure automatic sectionalizing on any network regardless of its complications.

IDENTIFICATION SCHEMES FOR STEAM AND WATER PIPES.

In most power plants and electrical generating stations electrical circuits and control apparatus is marked and identified in a conspicuous and practical manner, because it may be necessary at any time to be able to identify and segregate a circuit, a circuit breaker, transformer, etc., at any time on short notice.

What is done for the electrical equipment should also be done with the apparatus for the steam and water. Both are as important as the electrical equipment; although it is true less attention and less hasty action is usually called for. High-tension wiring is often colored red, the low-tension blue or black. So too low and high-pressure steam piping should have colors that discriminate between them. Live and exhaust steam pipes, pipes for oil, for water for turbines and for house service should have distinctive colorings. Pipe coverings should be stenciled also.

In addition to distinctive coloring of pipes, it is well to tag them. Tags should be placed at locations where it would otherwise be difficult to trace continuity, for example where a pipe enters another chamber and turns around. All valves should be tagged. Using distinctive colorings for the different pipes saves time and lessens accidents due to mistakes. Stencils and tags serve to identify the various pipes of the same class of service.

Contracting-Construction

Connection and Operation of Autotransformers — Estimators' Association—Report of New York State Meeting

METHOD OF CONNECTING AND OPERATION OF AUTOTRANSFORMERS.

Use of This Device for Connecting Lights to Power Circuits Not Generally Understood.

By J. D. Bernard.

It is often desirable in large manufacturing plants using alternating current to connect the power and lighting circuits to the same source of supply. In this way the additional expense of a separate service for each of these purposes is avoided and, in plants where the power is purchased on a maximum demand basis, the demand factor is reduced because the peak periods do not occur at the same time. Although the voltage on such circuits is subject to fluctuations due to the starting of motors, etc., which also affect the lighting, it is suitable for use in many places where the work is such that steady light is not necessary.

In the majority of plants such circuits are three-phase, 220 or 440 volts. In order to use this service for lighting either high-voltage lamps must be used, the lamps must be wired in series or a transformer installed to reduce the line voltage. On account of the greater cost of the high-voltage lamps and the difficulty of using the lamps in series, the latter method is usually employed. The transformers may be either of the ordinary type having primary and secondary windings or it may be an autotransformer having but one winding with a middle tap brought out. On 220-volt circuits the autotransformer is generally used and from the difficulties encountered, it is evident that many contractors do not thoroughly understand the connection and operation of this apparatus.

The function of the autotransformer when used in this way is simply to supply a neutral wire having the same difference of potential from either of the line wires. Its installation on one phase of a 3-phase 220-volt system, therefore, is equivalent to a 3-wire, 110/220-volt system, as shown in the accompanying diagram. This neutral tap is only required to take care of the unbalanced portion of the load as the balanced portion can be considered as being in series across the line. For example, in the diagram eight lamps are shown connected to the circuit, three to one side and five on the other. If all these lamps were in use at one time, three lamps on one side would be in series with three on the other, leaving only the two lamps on one side that would be supplied through the autotransformer. If each of these lamps was of 200 watts capacity, the load on the autotransformer would be 400 watts while the entire load would be 1600 watts. It is evident therefore that the size of the autotransformer is dependent upon the size of the probable unbalance in the load. This unbalanced portion of the load will average about 25% of the full load but will vary according to local conditions and the wiring layout. The size of conductor to be used, however, is determined by the connected load and the same rule that is ordinarily followed in making 3-wire, 110/220-volt installations should be used.

When an autotransformer is used on a 3-phase system on which the neutral point of one of the transformers is grounded, as is the system shown in the diagram, it should be installed in this phase, rather than either of the other phases. The reason for this is that there is a difference of potential between the neutral point of either of these other phases and the ground which would prove dangerous should a ground develop in the wiring. Where for some reason it is not possible to install the autotransformer on this phase or where the system is not grounded, a ratio

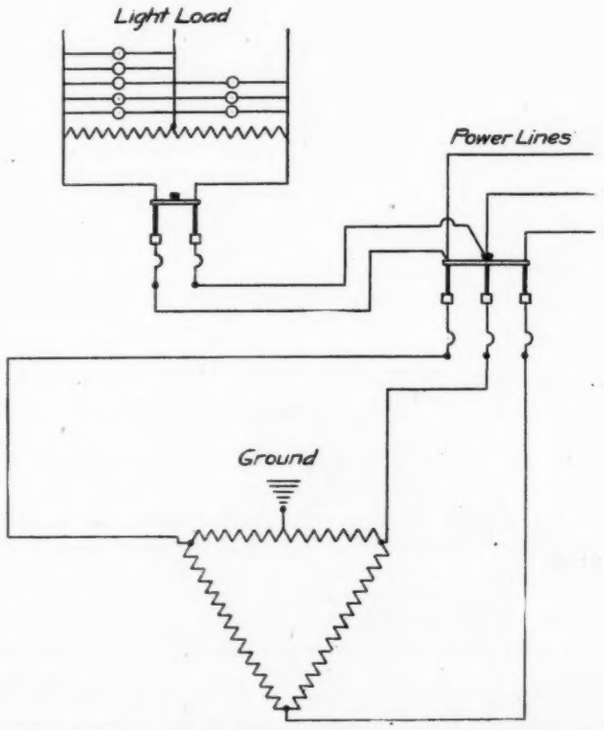


Diagram Showing Method of Connecting Autotransformer in 3-phase Power System.

transformer having two windings is recommended. Such a transformer, of course, provides for the entire load and its size therefore must be determined accordingly.

In installing an autotransformer the switch or fuse protection should be connected ahead of the device rather than between it and the load. The reason for this is that should one of the fuses blow between the autotransformer and the load, the entire load on one side of the line would be carried by the autotransformer which would undoubtedly burn it out. With the switch connected ahead of it, however, the blowing of a fuse only cuts the service off. The actual connection of the autotransformer is very simple as

the leads are always marked and only have to be connected to the proper lines.

NEW YORK CITY ELECTRICAL ESTIMATORS FORM ASSOCIATION.

Electrical Estimators' Club Organized to Study Conditions and Benefit Members.

The electrical estimators of New York City have organized an association to be known as the Electrical Estimators' Club of New York. According to the constitution the purpose of the organization is to study the values of the electrical devices and methods which may be included in making up an estimate of the costs of electrical construction: to promote more intimate acquaintance and good fellowship among those who estimate electrical work; also, by the interchange of experiences, ideas and assistance to raise the efficiency of its members. Membership in the club is open to any person estimating electrical construction work.

In order that the work of the club may be carried on as rapidly and efficiently as possible, several committees have been appointed, each to investigate and report on a certain subject. In order to stimulate interest in the association's activities among its members, the constitution provides that the appointments to such committees be so divided that as many individuals as possible serve on them. Other articles having the same tendencies have also been incorporated in the constitution. One of these is that every member, including the officers, should rise at least once during a meeting and express at least one thought on the subject under discussion. The other states that the officers shall be elected for a term of one year and, with the exception of the secretary, no officer shall be eligible to re-election to succeed himself.

John B. Curtis, of J. Livingston & Co., Inc., 70 East 45th street, has been elected president.

NEW YORK STATE CONTRACTORS DISCUSS BUSINESS RELATIONS.

Many Interesting Papers on this Subject Presented at Convention in Saratoga Springs.

All phases of the electrical contractor-dealers business were brought up and thoroughly discussed at the annual convention of the New York State Association of Electrical Contractors and Dealers held in Saratoga Springs, N. Y., June 23 to 25, inclusive. The success of the convention as well as the future success of the state association is indicated by the expressions from all groups of the industry who were present and took an active part in the proceedings. Chairman M. H. Johnson presided.

On Monday morning, prior to the formal opening of the convention a meeting of the Executive Committee was held at which the reports of officers and committees were presented and discussed. The treasurer's report showed the finance of the association in a very sound condition with a sufficient surplus for active organization work. The Insurance Committee recommended an agreement with Mr. Block of the Utilities Indemnity & Exchange for group insurance covering the membership policies through which a considerable saving in premiums will be effected. The Labor Committee, appointed at the January 1919 meeting was continued with instructions to prepare a universal form of agreement between labor unions and district associations, the members of which employ union labor. It is hoped through this course to standardize labor conditions throughout the state and avoid discussion and controversy which have been a source of more or less misunderstanding in the past and also obviate the possibility of any agreement clauses the legality of which might be questioned. The report of the Membership Committee showed that at the time of the transfer of the association from the old to the new constitution which occurred at the 1918 convention the membership was about 150 and is at present approximately 450, several new districts have been formed and the names of their Executive Committeemen submitted and approved.

The convention was opened with an address by Mayor Schwartz of Saratoga Springs in which he welcomed the delegates and their guests. W. C. Peet, chairman of the National Association, responded and, in the absence of W. H. Morton, described the work that was being done by the national body particularly in regard to the Data and Sales book and the new educational campaign. C. C. Dailey of Rochester, N. Y., then explained overhead costs and their application in estimating wiring. This feature of the contractor-dealers business although a very important one has been sadly neglected in the past but during the past year has received considerable attention. Mr. Dailey was followed by Lynton T. Block of the Utilities Indemnities & Fire Exchange, St. Louis, Mo., who described the operation and effects of compensation laws and liability insurance.

W. L. Goodwin of the General Electric Co., author of the Goodwin plan addressed the members on merchandising on Tuesday and on general topics of interest on Wednesday. Both subjects were treated in a way that he has never excelled if equalled, on previous occasions.

The other speakers on Tuesday were: Samuel A Chase of the Westinghouse Electric & Manufacturing Co., who described in a very interesting manner the "Channels of Distribution Between Manufacturer and Consumer," and which is reproduced, substantially in full, in another part of this issue. W. A. Kennedy of New York City, whose subject was "Wholesale Only and Its Co-operative Benefits;" J. T. Hutching. Rochester Railway & Light Co., who explained the effect of central-station rates for service on the contractor-dealers business. F. G. R. Gordon of Haverhill, Mass., spoke on "The Menace of State Socialism in America," which might be considered a departure from the usual routine of conventions; the information and statistics presented by him are a subject for serious thought for both business men and associations regarding fundamental obligations to their country as well as their business.

On Wednesday morning J. J. Raftery of New York City discussed the relations between the electrical jobbers and contractors. He was followed by Louis Kalischer, of Brooklyn, who delivered an interesting and instructive address on the "Advantages of Co-operative Selling Campaigns."

In addition to the regular sessions a meeting of the Joint Conference Committee, consisting of the representatives of the Empire State Gas and Electric Association, the Underwriters Association, and the New York State Association of Electrical Contractors and Dealers was held on Wednesday morning at which the previous work was gone over and their future program arranged. It was decided that its first activity will be the standardizing of services and meters in all districts of the state.

Contractor-Dealer

Plans to Encourage Installation of Convenience Outlets—Channels of Distribution from Manufacturer to Consumer

INSTALLATION OF CONVENIENCE OUTLETS TO BE POPULARIZED.

John G. Learned, Chairman Commercial Section, N. E. L. A., Introduces Plan to Promote Use—Of Interest to Contractor-Dealer.

Perhaps the greatest attempt that has been made thus far to promote the installation of outlets for the use of appliances is being introduced by the Commercial Section, National Electric Light Association through its chairman, John G. Learned of the Public Service Co. of Northern Illinois. In effect, the plan is an educational campaign to popularize the use of such outlets and thus to create a demand for them from the public.

Originally the manufacturers of electrical appliances, in their advertisements and window displays showed these devices connected to lighting fixtures. As their use in this manner was not approved by the inspection authorities and also because many of the more modern fixtures made such connections difficult, this practice was soon discontinued. Since this time the manufacturers have featured their devices showing the cord dead ended, that is, not connected to any outlet.

Through Mr. Learned's efforts several of the larger manufacturers have been asked to show their products in the future connected to a convenience service outlet. In this way the appliances can be illustrated in the most attractive manner and at the same time the added convenience of the outlet will be shown.

This campaign and the progress which has been made was outlined in a recent letter from Mr. Learned to E. W. Floyd of the Commonwealth Edison Co., which was read by O. R. Hogue at the recent convention of the Illinois State Association of Electrical Contractors and Dealers held in Decatur, Ill. In addition, the advantages to be derived by the contractor-dealers from the aid of such outlets was pointed out.

This letter is substantially as follows:

Chicago, Illinois, June 17th, 1919.

Dear Mr. Lloyd:

Confirming conversation with you of last evening relative to the Illinois State Association of Electrical Contractors and Dealers meeting at Decatur, I would appreciate it very much if you will bring to the attention of the contractors the importance of getting that body of men to feature the proper equipment of the home with special reference to installing adequate number of baseboard and wainscoting outlets so as to provide the facilities for the use of appliances.

Special reference should be made to the importance of proper electrical equipment for the bath room for the use of appliances. Although it is not generally known, the hair dryer, vibrator, curling iron, fan, and heater are valuable adjuncts in the bath room. In order to utilize such appliances it is only necessary to have one or two wainscoting outlets.

This matter is of vital interest to the contractors as it directly adds to the volume of their business and a concerted effort on the part of all contractors to exploit outlets will undoubtedly gradually create a greater demand not only from those whose homes are not wired but also from existing customers.

In line with this idea the Commercial Section of the N. E. L. A. in its activities is planning to get the manufacturers of appliances, accessories and other appurtenances used in home equipment to include in their advertising reference to an illustration of the baseboard receptacle.

This matter has been brought to the attention of the Edison Electric Appliance Company which company at present only illustrates appliances with the dead end of the cord.

The idea is to show both ends of the cord. The matter has also been brought to the attention of the Cutler Hammer Company. Both companies are showing considerable interest.

If this is taken up in a big way and we ask all the manufacturers who do national advertising to cover this feature in their advertising, I believe that after a reasonable period of time the public will be subconsciously impressed with the idea of proper wiring.

It is self evident that it is to the mutual advantage of everyone engaged in the electrical industry. It follows as a matter of course that the manufacturer will sell more appliances, the contractors will do more wiring, the accessories manufacturers will turn out a larger volume of products and last but not least, the central-station company will enjoy added revenue, and probably most important of all, it will make it easier to sell merchandise.

I have already spoken of this matter to Mr. L. H. Lamont, of Lamont & Company, 9 S. Clinton Street, Chicago, who is a member of the Commercial Section Executive Committee. . .

Yours very truly,
(Signed) JOHN G. LEARNED.

In order to realize the best results from this campaign however, the fullest co-operation must be received from the electrical contractors and dealers. As stated in the letter the installation of more outlets will result in added profits for wiring which should be of interest to the contractor. In addition, as the general trend at present is for contractors to conduct retail stores in connection with their wiring business, the fact that it will make it much easier to sell appliances should be especially attractive at this time.

Reproduction of May Display of Hotpoint Irons Showing Appliance Connected to Convenient Wall Outlet.

The co-operation of the contractor-dealer can be rendered in two ways. First, by an earnest effort to have a sufficient number of outlets included in the original wiring specification. It is a well-known fact that the installation of outlets is much more expensive if it is done after the building is completed or as an extra. Furthermore, it is much easier to persuade the owner to have outlets installed at this time. Sec-

ondly, contractors and dealers should follow out the plan suggested in their stores, windows and local advertising by displaying appliances connected to such outlets and encouraging their installation in every possible way.

In the accompanying illustration is shown one of the recent window displays furnished to its dealers by the Edison Electric Appliance Co., Chicago, featuring the Hotpoint electric iron. As illustrated the convenience of the iron is more clearly brought out by showing the cord so connected that it will not interfere with its use.

THE CHANNELS OF DISTRIBUTION FROM MANUFACTURER TO CONSUMER.

Paper Presented Before the New York State Association of Electrical Contractors and Dealers at Saratoga Convention.

By Samuel Adams Chase

Special Representative, Westinghouse Electric & Manufacturing Co.

The channels of distribution in the electrical industry are indefinitely marked with the trade beacons of trade organizations, proper trade differentials and a proper code of practice and ethics, supported by absolute knowledge of what each of these beacons mean to the captains of this industry and reminds one of a mariner who endeavors to pilot a ship through a river which was not clearly marked with safety beacons.

In considering this subject three important factors should properly enter into the discussion, the economic distribution, effective distribution and adequate distribution. The product to be distributed is made up principally of merchandising or resale electrical appliances and supplies and does not include, in its bills of lading, lighting or power apparatus.

The various channels of distribution in the past from the manufacturer to the consumer may be divided into the following groups: By the manufacturer direct; by the jobber-wholesaler; by the manufacturer's agent; by the central station; by the hardware merchant; by the dry goods store; by the drug store, and in some instances by various other merchants not strictly in the electrical supply business; and by the contractor-dealer.

The manufacturer has frequently made the mistake in the past of being allured by the temptation to obtain the middleman's profit and has taken small orders direct from the consumer, at an apparent profit. He has learned by costly experience however, that this so-called profit is wiped out by the cost of obtaining and handling the orders and the result is not only a net loss in money but a disturbed and unhealthy condition in the trade. It has in some instances taken years of experience to teach the manufacturers the wisdom of a policy of selling their merchandising product to the consumer through the middleman, recognizing the service rendered by the jobber and the contractor-dealer.

He has, in some instances, chosen the direct route to consumers in the past due to the uneconomic, ineffective and inadequate distribution through other channels and a hesitancy on the part of the middleman to create a sufficient demand for the goods manufactured and although a definite sales policy has been adopted by some manufacturers of selling direct and through the middleman at the same prices, their direct sales exceed all others by a large percentage notwithstanding the local influence of the middleman.

It is safe to assume, however, that the average manufacturer will welcome the day when it will be possible to economically and efficiently distribute his merchandising product exclusively through the electrical jobber and retailer. But, these channels are not yet deep or broad enough or sufficiently safe and efficient to warrant any manufacturer with a large sales organization to sell exclusively through them.

The jobber or wholesaler in the past, and in some instances at present, did a retail business in addition to the wholesale business and, in some cases sold to consumers without recognizing, in the form of a differential, the service rendered by the contractor-dealer. This practice is not only unethical but demoralizes the contractor-dealer's business to such an extent that it makes that class seemingly distrustful and quite naturally has a tendency to prevent his engaging in the retail business, hence retarding sales and expansion. In addition the jobber of the past has been somewhat like many manufacturers' agents and has shipped an order calling for a miscellaneous lot of goods direct from the various manufacturers because of not carrying a sufficient stock in his warehouse, causing delayed and expensive shipments. The jobber of today however, assembles all these goods in his own warehouse and distributes complete, in one shipment, frequently the same day the order is received, which is of great advantage to the contractor-dealer. Therefore, the jobber can be the natural, economic and efficient channel of distribution from the manufacturer to the contractor-dealer.

The manufacturers agents' policies vary. Some carry a small stock and ship and invoice customers. Others carry no stock and are simply order takers for the manufacturer and some sell indiscriminately to jobbers, contractor-dealers, and consumers, and should in reality be classed as salesmen for the manufacturer.

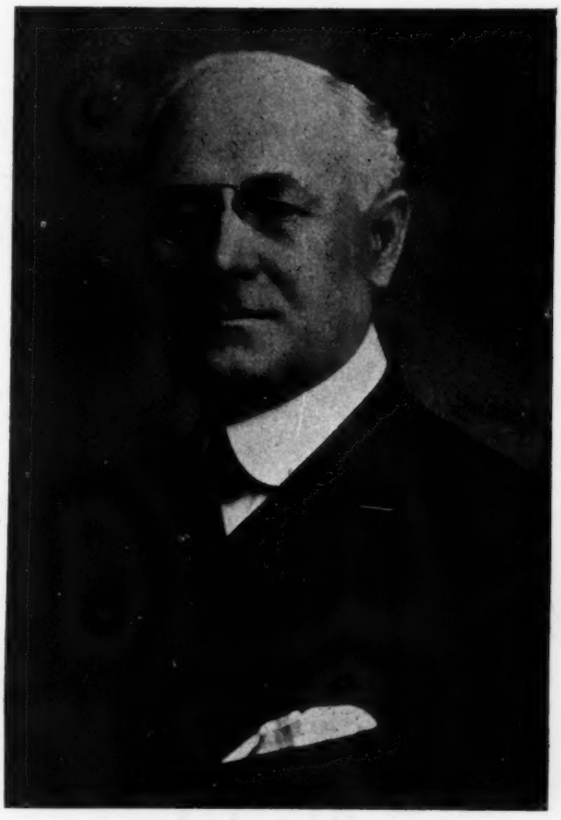
The central stations have been pioneers in the sale of and distribution of incandescent lamps and that channel was marked with beacons of free renewals and cut prices, allyring the industry not to a haven of safety but to a rock-bound coast of disaster. Now, the channel has changed to the jobber, contractor-dealer and central station, with the percentage clearly marked with beacons of ethical merchandising and intensive selling, producing absolute fairness in competition between the competing groups—and the contractor-dealer with a well-located attractive retail store now plays an important part in the channel of distribution of lamps from the manufacturer to the consumer. The flat iron, washing machine and vacuum cleaner and other household appliances were also introduced principally by the central station and it is believed that the central station on account of its organization, prestige, financial responsibility and desire to add kilowatts to its lines, will always be the logical pioneer and pilot the way for the jobber and contractor-dealer. It would be very unfortunate to the manufacturer and the consumer if the central station should go out of the retail business properly conducted on an ethical basis, for central stations will always carry the introductory or development expense of placing new devices on the market.

The hardware, dry goods, drug store, and kindred merchants have probably done more to advertise electrical merchandising products than other distributors, but in their advertising, like some central station advertising, the principal story is cut-prices. With their

recognized business ability attractive stores and display windows and unquestionable financial standing, however, the call of this siren has been so alluring that it has wrecked many a manufacturer's ship in the channel of distribution to the consumer.

Each of these groups, however, creates and obtains a certain amount of business which ordinarily could not be obtained by strictly electrical concerns principally because these merchants make it easy for the housewife to obtain electrical appliances. Their stores are attractive, located in the shopping district frequented by ladies and in charge of an efficient sales organization, and they will continue to increase their electrical departments and sales and will attract the manufacturer as one of the efficient and economic channels of distribution, unless the contractor-dealer becomes alive to the situation and the necessities of the public and adopts such methods.

The beneficial results of a plan of scientific merchandising, practical trade co-operation and organization as advocated by Mr. Goodwin and which has been so ably supported by the electrical press, manufacturers, jobbers and central stations, will unquestionably result in making the specialized electrical retailer the dominating channel of distribution from the manufacturer to the ultimate consumer. The contractor-dealer has not until recently become a merchant for the reason that apparently all classes in the industry have looked upon him as a necessary evil rather than an economic necessity. All other classes in the industry have been cultivated to a high degree but the contractor-dealer until recently has been allowed to drift, unaided, uncultivated, and looked upon as a parasite, superfluous in the channel of distribution and, rudderless, without a beacon light to guide him, has been wrecked on the rocks of commerce. Because of these facts, and realizing there was no stability to the prices of merchandising appliances or wiring devices, he has not taken advantage of the opportunity presented and opened a sufficient number of attractive retail stores. The channel of distribution from the manufacturer to the consumer *via* the electrical dealer route therefore, has made it difficult rather than easy for the housewife to purchase electrical appliances.



Samuel Adams Chase.

Channels of distribution like rivers cannot be forced from the manufacturer to the consumer through uneconomic channels. However just as the channels of navigation in a river change from time to time due to natural elements which may be changed through the medium of engineering talent and modern machinery, so may the channels of distribution of electrical merchandise be changed by the application of scientific merchandising methods directed by the best thought and activity of the contractor-dealer. The author is firmly convinced that by an aggressive sales policy in co-operation with the jobber, coupled with active interest in his association and the most friendly relations with manufacturers, central stations, consulting engineers, builders and architects, the contractor-dealer will gradually become a dominant factor in the distribution of materials.

It is to be hoped that the time will come when every contractor-dealer will be a member and attend all state conventions and at these meetings representatives of manufacturers, jobbers, central stations, architects, engineers and the press will be included so that all can appreciate and understand the problems of the others, thereby establishing friendly and ethical relations, and facilitating distribution.

The trade seeks the channel of least resistance. The better business man the contractor-dealer develops to be, the more prominent the location of his store, the character of his store, the support which he gives to his trade associations, the manner in which he conducts his trade association, the character of officers of his association, and the conduct and manner of presenting his trade problems to the manufacturer or jobber all tend toward removing barriers and resistance and aid in directing the flow of trade through the contractor-dealer channel. The manufacturer is faced with a choice of channels for the distribution of his product. In one channel is the palatial department store, well managed, with unquestionable credit standing; in another, the central station and the jobber, and in another the contractor-dealer, who in the past has not always appealed to him in a favorable light. With the methods now being employed, however, with attractive retail stores, located conveniently for the buying public, intensive sales methods, improvement in organization, proper presentation of problems through able committeemen presenting forcible rather than arbitrary arguments, the contractor-dealer is every day commanding a higher respect from manufacturer, jobber and central station, and is causing them all to think, and to think hard, which must result, if they continue along these constructive lines, in causing an increasing percentage of business to flow from the manufacturer through the jobber-contractor-dealer channel.

In conclusion it is suggested that in the channel of distribution in which the contractor-dealer navigates, the beacons be labeled—organization, co-operation, ethical merchandising policies and determination. With these slogans properly applied there can be but one answer and that is the contractor-dealer ship will be the flag ship and lead the squadron through the channel of distribution from the manufacturer and jobber to the consumer.

New Appliances

Special Ampere-Hour Meter to Insure Proper Charging for Tractors and Trucks—Fan to Promote Kitchen Comfort

Locomotive Type Ampere-Hour Meter for Truck, Tractor and Locomotive Battery Charging.

The experience of the past few years in the operation of storage-battery trucks, tractors and battery mine locomotives has clearly demonstrated that the chief problem in the operation of these devices is the problem of the storage battery. Accordingly, the ampere-hour meter, which is the only device that automatically gives a true indication of the state of charge of the storage battery at all times and can be made to automatically terminate the charge at the proper time, is of special importance in this connection. A new locomotive type ampere-hour meter has just been designed by Sangamo Electric Co., Springfield, Ill., in order to meet the severe requirements as to overload and vibration experienced in this particular service.

Ampere-Hour Meter Control.—The ampere-hour meter, when installed permanently in the storage-battery circuit on the truck, tractor or locomotive, registers every ampere-hour which the battery discharges in driving the vehicle, and since the total battery capacity is indicated by the red "Empty" hand on the meter, the black hand indicates the remaining capacity left in the battery. The operator then knows at all times how much farther he can run the truck. When the battery is later put on charge the ampere-hour meter registers as the charge proceeds, operating in a direction reverse from that of discharge. When the battery has been fully charged the meter will register zero and make a contact within the meter which trips the circuit-breaker in the charging circuit.

Automatic Charging.—No battery is 100% efficient. More charge must be given than was taken out on the previous discharge, so there must be a certain amount of excess charge each time the battery is charged. This feature is automatically provided for in the locomotive type ampere-hour meter by means of a variable-resistor device, which causes the meter to run slower by any desired percentage on charge than on discharge for equal current flow. This automatically provides that the battery will be given any desired percentage of overcharge, for by the time the meter indicating hand gets back to the full charge position, all of the previous discharge plus a certain percentage of overcharge (depending upon the setting of the variable-resistor element) will have been put back into the storage battery. This feature is entirely automatic, and once the resistor has been set at the desired percentage of overcharge, no further attention need be given the device.

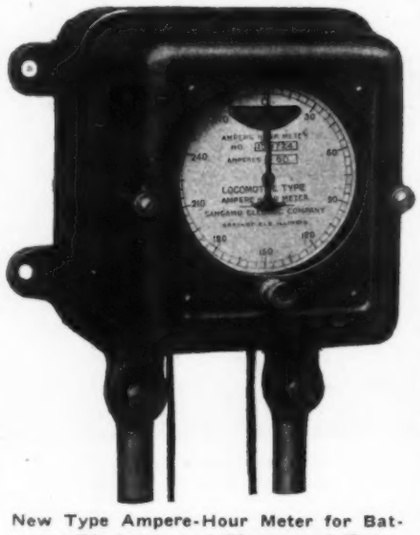
Special Features of Locomotive Type Meter.—The locomotive type meter, which has been especially designed to meet the severe requirements of mine locomotive and industrial truck service embodies several distinct improvements over previous Sangamo ampere-hour meters.

1. *Overload Capacity Increased.*—The locomotive type meter will carry 300% load continuously and 500% load for 3-minute periods without undue heating of any part.

2. *Meter Made Dust and Moisture-proof* by means of improving binding posts, terminals and soft rubber gasket in case.

3. *New Type Contact at Zero.*—This is mounted entirely back of the dial and operates on cam principle instead of lever as formerly, thereby reducing the drag on meter and increasing reliability of the action of the contact.

4. *Modified Motor Element.*—Special treatment is given to both the armature disk and armature box interior which has reduced the formation of mercury dross to about ¼ of that formerly experienced. This will probably improve the meter operation very greatly and eliminate trouble due to meters being slow on account of dross.



New Type Ampere-Hour Meter for Battery Discharge and Charge and Terminating Latter at the Proper Point.

5. *New Type Variable-Resistor Element,* which is approximately eight times as effective as the resistor element formerly used. This insures great reliability of operation and increases the range of adjustment so as to provide a maximum of 50% overcharge where desired.

6. *Reset Made Dustproof.*

7. *Lock Washers* throughout and special rugged construction combined with mercury flotation of the rotating element, making the locomotive type meter immune from vibration and loads.

Ilg Electric Household Kitchen Exhaust Fans.

Comfort is an essential to efficiency in the home as well as the factory, store or office. The kitchen in the average home is the room that is most neglected as far as provision for comfort is made therein. This is one of the reasons why many housewives do not like to cook and also why domestic servants willing to cook are steadily decreasing in number. One of the most important aids to kitchen comfort is a proper electric exhaust fan to remove the hot, humid and often malodorous air so commonly found in the kitchen, especially when the latter is located in a portion of the building where natural ventilation is difficult or impossible. Even where the winds may have access to the kitchen window and door, they are an uncertain quantity and as likely to blow the kitchen odors and smoke into the other rooms of the house or apartment as to blow them out.

The Ilg Electric Ventilating Co., of Chicago, Ill., which claims to be the largest exclusive manufacturer of electric ventilating equipment, has made a special study of kitchen ventilation as a result of which it has developed an exhaust fan especially suited for this service. This fan is small, quite neat in appearance and quiet in operation. It is easily installed in the upper portion of a window, in a transom or special wall opening. Its current consumption is low enough to permit operating on the ordinary house lighting circuits. The motor is fully enclosed as a protection against heat and grease. The latter would quickly choke up the motor, cause overheating of it and result in possible fire. Like other Ilg fans, these exhaust outfits have a patented self-cooling feature, by means of which cool air is drawn through the motor enclosure and carried off with the general exhaust. This keeps the motor windings at safe operating temperature. The air drawn through the case being clean air, the windings are kept from being choked up.

Use of these Ilg kitchen exhausters has been found to promote comfort in the cooking since the kitchen is kept from becoming hot, stuffy and malodorous. They also prevent the kitchen odors, fumes and smoke from entering the other rooms to the annoyance of other members of the family and guests, and by withdrawing them promptly they are also prevented from smudging and otherwise spoiling wall decorations, pictures, etc.

In order to assist its dealers in the sale of this fan the company has arranged a very attractive window display. This consists of a three-panel mounting, decorated to represents a kitchen interior in which a real fan can be mounted and operated in the dealer's window.

Trade Activities

Ohio Electric & Controlling Co. Appoints Representatives —Harrison Safety Boiler Acquires Monash Equipment

Edison Electric Apliance Co., Inc., Hughes Division, has issued a circular offering to dealers stereotypes of four advertisements on electric ranges so they may tie in their local newspaper advertising with the national advertising campaign now being conducted by the company. These are furnished in single, double or triple column size and provide space for the dealers' name.

Murray Iron Works Co., Burlington, Iowa, has appointed S. C. Orrell its Chicago district sales manager with headquarters at 1215 Conway building. Mr. Orrell was for many years identified with the Chicago office of Allis-Chalmers Manufacturing Co., later becoming Minneapolis district manager for the company. Mr. Orrell will prove a valuable addition to the staff of the Murray company.

Jewell Electrical Instrument Co., 1646-50 Walnut street, Chicago, is distributing a new 72-page catalog on electrical measuring instruments, which is one of the most complet catalogs dealing with this equipment ever published. The descriptive matter has been very carefully and accurately written, giving brief and comprehensive data and information on each instrument. All portable instruments are first described and illustrated, following which is the switchboard equipment. A feature of this catalog is the very complete and convenient set of charts in which each instrument is listed with all ranges of readings and prices. All shunts, transformers and multipliers are illustrated and described. Some 12 pages are devoted to full size reproductions of instrument scales, diagrams showing shunt dimensions, drilling dimensions and series transformer dimensions.

Electric Storage Battery Co., Philadelphia, Pa., recently received from a number of its customers, letters of testimony bearing evidence of the efficiency of the industrial electric truck. One of the firms that is using an industrial truck with an "Ironclad-Exide" battery states that six men who received an average pay of 42 cents per hour have been replaced by using one industrial truck of two-ton capacity. Another informs that in addition to the saving of labor, the trucks are hauling material from one place to another in less than one-third of the time formerly taken. These are but two of thousands of similar installations where the industrial electric vehicle has proven itself to be a most efficient transportation labor-saving equipment. However, the full efficiency of any industrial truck or tractor is only realized when it is equipped with the proper make and type of battery, and in this connection the "Ironclad-Exide" has rendered admirable service.

The Industrial Electric Furnace Co., 53 West Jackson boulevard, Chicago, now owns all patents covering the Snyder electric furnace, E. T. Snyder, formerly vice-president, having left the organization, effective June 1.

Harrison Safety Boiler Works, Philadelphia, Pa., has acquired the Monash line of pressure reducing valves and pump governors, formerly manufactured and sold by the Monash-Younker Co., of New York and Chicago. The purchase includes a stock of manufactured parts and valves, drawings, patterns, trade mark and good will. The Harrison Safety Boiler Works will manufacture and market the valves under the trade name "Cochrane-Monash," and will supply repair parts for valves now in use.

Illinois Electric Porcelain Co., Macomb, Ill., has issued a new catalog on electrical porcelain insulations. This contains 24 pages, for the most part full size sections and part elevations of various forms of porcelain insulators, standard porcelain electrical parts and special porcelain. Included among these are standard and split knobs, one, two and three-wire cleats, switch bases, ceiling buttons, strain insulators, pin bases, rack insulators, exterior and interior bushings, leading-in-tubes, pole-line screw-thread insulators and standard unglazed tubes. In connection with the latter an interesting table of numbers of tubes of various sizes in the standard barrel and gross weights of various tubes in a standard barrel are given.

Cutler-Hammer Manufacturing Co., Milwaukee, Wis., has given the title "Helps in Merchandising Electrical Appliances" to a new 16-page two-colored booklet because all the 1919 advertisements reproduced in it request the public to go to the electrical dealers. Last year the company had to postpone on account of war restrictions its second national advertising campaign on the C-H Seventy Fifty switch which is used on the cords of heating devices and many other electrical appliances. For the 1919 campaign the original advertisements have been increased in size and number and additional national media are being used. Reproductions of all the advertisements which have or will appear in the *Saturday Evening Post, Literary Digest* and *Good Housekeeping Magazine* this year, are shown.

In addition, several new and interesting helps for dealers have also been provided, such as a four-color lithographed window trim, street car cards, window and wall display cards, three or four two-color booklets which are imprinted for dealers' use, colored "movie" theater slides and eight little stickers for use on letters going forth from lighting companies, dealers and jobbers, contractors and others. Besides this, there are eight newspaper advertisements, complete electros of which can be had by the dealer. These newspaper advertisements play up strongly the use of electrical appliances of all kinds and point out the convenience to be secured when such appliances are equipped with the C-H Seventy Fifty switch. They will, therefore, increase interest in the use of all makes of household electrical appliances and when used by the dealer at the time the national advertising is appearing, will help to tie-up his store with the national publicity and increase his sales of electrical appliances of all kinds.

Belden Exhibit at Telephone Convention.—One of the most interesting exhibits of the recent United States Independent Telephone Association convention at Chicago was that of the Belden Manufacturing Co., 2300 South Western avenue, Chicago. A high-speed braiding machine for braiding wire and cordage was set up and operated during the three days of the convention, showing the process of manufacturing many different types of cordage and wire with silk and cotton braids. This was a very interesting novelty to many convention visitors. A motor-driven coil-winding machine, which the company manufactures for the trade and numbers of which are used in its coil-winding department, was in operation, making numerous coils wound with enamelled wire manufactured by this company which is well known under its trade name "Beldenamel."

The Ohio Electric & Controlling Co., 5900 Maurice avenue, Cleveland, Ohio, announces the appointment of the following firms as its representatives: The Iron & Steel Equipment Co., 1502 First National Bank building, Pittsburgh, Pa.; Williams Beasley Co., 343 South Dearborn street, Chicago; Linn O. Morrow, 707 Franklin Trust building, Philadelphia, Pa.; J. W. Dopp & Co., 18 Columbia street, Detroit, Mich.; Kelly, Powell, Ltd., 403 McArthur building, Winnipeg, Can.; Wonhan, Bates & Goode, Inc., Dominion Express building, Montreal, Can.; Shook & Fletcher Supply Co., Birmingham, Ala. The company has also appointed foreign representatives as follows: Wonham, Bates & Goode, Inc., 17 Battery place, New York City, London, Paris, Havana and Rio de Janerio; Mitsui & Co., 65 Broadway, New York, Japan, China, Philippine Islands and Honolulu, and Gustav Neilson, A. S., Christiania, Norway, Sweden and Denmark.

Current News

Weekly Record of Construction Activities—Conventions

EASTERN STATES.

Rutland, Vt.—Western Vermont Power & Light Co. has been awarded a contract for furnishing electric energy for the operation of a large new plant at Fair Haven, Vt., manufacturing shirts. The plant is electrically operated throughout, and considerable power will be required for a large number of electric irons.

Boston, Mass.—In connection with the construction of a new four-story publishing building, at 240 Washington street, to be occupied by the Boston Globe Co., estimated to cost $100,000, considerable new electrical equipment will be required.

Chelsea, Mass.—Power Efficiency Corp., While building, Buffalo, N. Y., has submitted low bid to the Government, Navy Department, for the installation of the proposed heating system, etc., at the local naval station.

Gardner, Mass.—Gem Crib & Cradle Co., Main street, has recently broken ground for the construction of a new power plant at its works, to be used for factory operation. Heretofore power has been furnished by the Connecticut River Power Co.

Leominster, Mass.—Plans are under consideration by the City Council for an appropriation of $75,000 to be used for municipal improvements, including improvements in the street lighting system.

Worcester, Mass.—City Council has voted a loan of $50,000, to be used for construction work in connection with the new reservoir at Pine Hill for the waterworks system.

New Haven, Conn.—In connection with its proposed plant on Hallock avenue, the Seamless Rubber Co. will build a power plant for factory operation. The works will comprise three main buildings, each five-story, about 60x240 ft. It is said that the entire plant will cost about $1,000,000.

Waterbury, Conn.—A one-story power house, 35x60 ft., will be built by the American Brass Co. at a cost of $50,000.

Providence, R. I.—Atlantic Mills have awarded a contract to O. D. Purington & Co., Industrial Trust building, Providence, for the construction of a new three-story power plant about 46x98 ft. at its works at 120 Manton avenue. The structure is estimated to cost about $25,000.

Albany, N. Y.—Contract has been awarded to the General Electric Co., 527 West 34th street, New York, by Edward S. Walsh, State Superintendent of Public Works, for furnishing and delivering electric capstan and trolley hoists at various barge canal terminals, under Barge Canal Terminal Contract No. 113, at $14,090. Frank M. Williams, Telephone building, is state engineer and surveyor.

Brooklyn, N. Y.—Mergenthaler Linotype Co., 24 Ryerson street, has had plans prepared for alterations and improvements in its one-story boiler plant, to facilitate operations. Estimated cost $6000.

Brooklyn, N. Y.—Edison Electric Illuminating Co., 360 Pearl street, has filed plans for the erection of a new addition to its plant on 66th street, for increased capacity. Contract for the structure has been awarded to the Hamilton & Chambers Co., 1290 Broadway, New York.

Brooklyn, N. Y.—Bureau of Yards and Docks, Navy Department, Washington, D. C., is planning for a boat storage works at the Brooklyn navy yard, to cost about $45,000. The equipment will include two electric traveling cranes.

Buffalo, N. Y.—Robertson-Cataract Electric Co. will erect a six-story addition to its plant to cost $80,000.

Dansville, N. Y.—Power Specialty Co., manufacturer of steam and hydraulic specialties, is preparing plans for the erection of a two-story addition, to cost about $25,000.

Iroquois, N. Y.—Board of Managers of Thomas Indian School has awarded a contract to the Millenburg-Betz Machine Co., 110 Washington street, Buffalo, for the installation of new refrigerating equipment at the institution, to cost about $7325. Lewis F. Pilcher, Capitol building, Albany, is state architect.

Montauk, N. Y.—The Bureau of Yards and Docks, Navy Department, is taking bids on revised plans for the construction of the proposed power plant (Specification 3889) at the local naval station. C. W. Parks is chief of the Bureau of Yards and Docks.

New York, N. Y.—Considerable electrical equipment, including electric-operated traveling cranes, etc., will be installed in the new five-story building, about 125x100 ft., recently leased by Julius Blum & Co., 510-12 West 24th street, iron mouldings, etc. Extensive alterations and improvements will be made in the structure previous to occupancy by the company.

New York, N. Y.—New York Edison Co., Irving place and 15th street, has recently been awarded a contract for supplying electric service for all operations at the American Surety building, a 20-story office structure, at 100 Broadway. The structure will require current for 5000 lamps and 500 hp. in motors.

New York, N. Y.—Alpha Electric Co., Inc., 116 West 29th street, has leased property comprising about 22,500 sq. ft. of floor space at 151-155 West 30th street, for a new establishment, at an aggregate rental of $150,000.

New York, N. Y.—Reimers Manufacturing Co., 517 West 45th street, manufacturer of electric heaters, has leased property at 507-13 West 50th street, for a new establishment.

Potsdam, N. Y.—Dr. Thomas E. Finegan, deputy commissioner of education, Education building, Albany, has taken bids for the erection of a new boiler plant at the local normal school, including the installation of new heating equipment and electrical work.

Dover, N. J.—New Jersey Power & Light Co. has completed plans for the installation of new coal handling equipment at its new local plant. The company has recently been awarded a contract for furnishing electric energy for the operation of new motors installed at the municipal waterworks.

Merchantville, N. J.—Board of Public Utility Commissioners has granted permission to the Merchantville Water Co. to increase its rates for service, effective July 1.

Newark, N. J.—Murphy Heating Co. has filed notice of organization to operate at 51 State street for the production of heating devices. L. and K. Murphy head the company.

Newark, N. J. — Public Service Corp. has had plans prepared for alterations and improvements in its building at the foot of Hudson place, to facilitate operations.

West Orange, N. J.—Highland Electric Co., 10 Freeman street, has filed notice of organization to operate an establishment for general electric repair work. Frank Rotalo and A. Pettis, West Orange, head the company.

Summit, Del.—Work has recently been completed on the installation of a new electric lighting system throughout the Brandywine Summit Camp grounds, near Wilmington, and it is expected to inaugurate operations at an early date.

Wilmington, Del.—Sterling Electric Co. has filed notice with the Secretary of State of an increase in its capital from $10,000 to $100,000, to provide for general expansion.

Beaver, Pa.—Harmony Electric Co., with headquarters at Pittsburgh, has arranged plans for the merger of a number of electric light and power companies now operating in Beaver County under its present name. Application has been made to the Public Service Commission for approval.

Philadelphia, Pa.—Bids are being taken by the Niles-Bement-Pond Co., Mifflin and Meadow streets, for the construction of the proposed boiler

plant at its works. The structure will be one story, about 44x60 ft.

Philadelphia, Pa.—Contract has been awarded by the Navy Department to the Enterprise Steam & Hot Water Heating Co., 600 North Howard street, Baltimore, Md., for the installation of new heating apparatus at the local navy yards.

Reading, Pa.—Metropolitan Edison Co. has recently commenced the construction of a second long-distance high-tension supply line to Lebanon, a distance of about 28 miles. The line will be equipped with insulation that will enable it to carry 66,000 volts, but operating voltage under present requirements will not exceed 33,000 volts, it is understood. The construction of this line will allow for the closing down of the generating plant at Lebanon, affording a saving in operating expenses of about $21 000 annually.

Titusville, Pa.—Titusville Light & Power Co. has arranged for the issuance of bonds for $15,000 to provide for general expansion. Notice has been filed with the Public Service Commission.

Zelienopel, Pa.—Large quantities of electrical equipment will be required in connection with the proposed construction of the new plant of the Universal Rubber Co., estimated to cost about $300,000. It is understood that the company is planning the construction of a second unit at a later date.

Cumberland, Md.—Western Union Telegraph & Cable Co. in conjunction with the Cumberland Division of the Baltimore & Ohio Railroad Co. has commenced work on the laying of underground cables for a new electric signal system, telephone and telegraph wires from the Queen City depot to the Viaduct tower, a distance of about three-fourths of a mile. The work is estimated to cost about $40,000.

Elkton, Md.—Town Council has recently completed negotiations with the receivers of the Maryland Water Co. for the purchase of its waterworks for a consideration of $35,375. It is understood that in connection with municipal operation of the plant, improvements will be made.

Hagerstown, Md.—Hagerstown & Frederick Electric Railway Co., operating five steam power plants and four hydroelectric stations, is negotiating with the city officials for the furnishing of electric current to the city for lighting purposes and for private utility by citizens. It is held by the company that this arrangement will afford an annual saving of a minimum of $10,000.

Lexington, Va.—Plans are being prepared by the Virginia Military Institute for the installation of two new 500-hp. boilers at the plant of the institution, estimated to cost $15,000. Carneal & Johnston, 707 Chamber of Commerce building, Richmond, Va., are engineers.

Norfolk, Va.—Columbia Peanut Co. desires prices on 80 to 100-hp. boilers and Corliss engines.

Clendenin, W. Va.—Kanaelk Coal Co. has had plans prepared for the erection of a new power plant at its local properties, in connection with other work. W. W. Whyte is president.

DATES AHEAD.

National Association of Electrical Contractors and Dealers. Annual convention, Milwaukee, Wis., July 15, 16 and 17. General manager, William H. Morton, 110 West 40th street, New York City.

Ohio Electric Light Association. Annual meeting, Cedar Point, Ohio, July 15-18. Headquarters, Breakers Hotel. Secretary, D. L. Gaskill, Greenville, Ohio.

Michigan Section, N. E. L. A. Annual convention, Ottawa Beach, Mich., Aug. 19-21. Headquarters, Hotel Ottawa. Secretary-treasurer, Herbert Silvester, Monroe, Mich.

Southeastern Section, N. E. L. A. Annual convention, Asheville, N. C., Sept. 17-19. Secretary-treasurer, T. W. Peters, Columbus, Ga.

International Association of Municipal Electricians. Annual convention, Chicago, Sept. 23-26. Secretary, Clarence R. George, Houston, Tex.

Association of Iron and Steel Electrical Engineers. Annual convention, St. Louis, Mo., September, 1919. Secretary, John F. Kelly, Empire building, Pittsburgh, Pa.

Washington State Association of Electrical Contractors and Dealers. Annual convention, Seattle, Sept. 11. Secretary, Forrest E. Smith, 205 Boston block, Seattle.

New England Section, N. E. L. A. Annual convention, New London, Conn., Sept. 22-24. Headquarters, Hotel Griswold. Secretary, Miss O. A. Bursiel, Boston, Mass.

National Association of Electrical Inspectors. Annual meeting, Springfield, Mass., Oct. 13 and 14. Secretary, W. L. Smith, Concord, Mass.

Illuminating Engineering Society. Annual convention, Chicago, Ill., Oct. 20-23. General secretary, Clarence L. Law, 29 West 39th street, New York City.

Taylorsville, N. C.—Plans are in process of formation by the Alspaugh Light & Power Co. for the construction of a new hydroelectric plant to be located about five miles from Taylorsville. The works will include the erection of a concrete power house, with dam, and a five-mile transmission system. T. C. Alspaugh is interested in the company.

Arlington, Ga. — Baker County Power Co. is understood to be considering plans for the construction of a new dam on Natchanny Creek, in connection with its proposed hydroelectric development.

Bowling Green, Fla.—Prices on 150-hp. boilers, 50-hp. engines and 50-kw. generators are wanted by the Bowling Green Manufacturing Co.

NORTH CENTRAL STATES.

Hamilton, Ohio.—An electric power plant is to be established at the Rockdale dam to furnish power for the Hamilton Furnace Co., which will double the capacity of its present plant.

Toledo, Ohio—The Fisher-Storey saw mill, recently destroyed by fire, will be rebuilt. The plant is to be motor driven, power being supplied from a power plant built as a part of the mill.

Fort Wayne, Ind—Pennsylvania Railroad will erect new air compressor in its power plant. The new apparatus will have a capacity of 2700 ft. per minute. Address Assistant Foreman Hosterman.

Gary, Ind.—Dorman and Sykes Auto Sales Co. will build a $100,000 building, three stories, which will be the second largest business block in Gary.

Gary, Ind.—Revescz Home Building Co. will erect 16 apartment houses at a cost of $225,000, two six-apartment buildings to be erected immediately.

Indianapolis, Ind. — The Indiana Public Service Commission has authorized the Union Traction Co. of Indiana to issue $150,000 worth of three-year promissory notes, dated July 1, 1919.

Indianapolis, Ind. — Indianapolis Belt Railroad Co. will expend $20,000 at the Indianapolis stock yards, the first important improvement being the erection of a new building, 200x 300 ft.

Indianapolis, Ind. — Indianapolis Cordage Co. will erect one-story warehouse, 140x200 ft., at cost of $30,000.

Richmond, Ind.—E. W. Steinhart Co., Indianapolis, will erect four-story concrete building to cost $125,000.

South Bend, Ind. — Studebaker Corp. has taken a permit for the construction of $700,000 factory building, 192x504 ft.

South Bend, Ind.—American Home & Investment Co. will erect forty-six new houses in this city.

Carlinville, Ill.—Macoupin county board of supervisors will install electric lights throughout the court house. Address Q. H. Bates, supervisor, Carlinville, Ill.

De Kalb, Ill.—De Kalb-Sycamore Electric Co. will erect a large cooling tower 80 ft. in height, and 12 to 15 ft. in diameter.

Mt. Auburn, Ill.—Wurl Electric Co. has applied for a permit to install an electric lighting system in Mt. Auburn, Ill., and to sell $5000 of its capital stock.

Elwood, Ind.—Sellers Kitchen Cabinet Co. has begun construction of four-story building, which will make the seventh building for this company. The State Construction Co. of Indianapolis has the contract. The new building will be of brick and structural steel.

Evanston, Ill.—The Illinois Public Utilities Commission has denied the right of the Chicago, Fox Lake & Northern Electric Railway to construct a suspended monorail railway between Evanston and the village of Palestine. The original petition was denied some months ago and the petition to reopen the case has also been denied. The company is authorized to cease taking subscriptions and from selling its one-year 7% gold notes.

Palmyra, Ill.—An order entered by the State Utilities Commission gives the Palmyra Light, Heat & Power Co. the right to construct and operate a transmission line from Palmyra to Waverly, and which is to extend to Modesto, for the purpose of furnish-

ing electric light to consumers along the proposed route. In addition the company is given the right to issue first mortgage bonds in the aggregate of $8,000. Address Lewis M. King, president.

Petersburg, Ill.—An electric line is being provided between Springfield and Rushville by the way of Petersburg and Chandlersville. John Rosenwienkyle, 2154 North Racine avenue, Chicago, is promoter.

Urbana, Ill.—The Urbana board of local improvements has decided to resurrect the ornamental lighting proposition once started for the southwest part of Urbana, including the territory south of University avenue and west of Market street. City Engineer A. M. Danelly is now at work on plans for the system which is expected to cost about $100,000.

Villagrove, Ill.—The failure of the Central Illinois Public Service Co., to furnish power has started the organization of a company to build power plant. Address city clerk.

Adrian, Mich. — United Electric Manufacturing Co. has acquired the site of the Lion Motor Co. plant, on which it proposes to erect a $100,000 plant.

Lansing, Mich.—The question of issuing $65,000 in bonds for extending the light and water power service is being considered by the local authorities.

Appleton, Wis. — Wisconsin Traction Co., will extend its line to nearby towns. Work on the extensions to Hortonville has been commenced.

Saginaw, Mich. — The council has been petitioned to have street cars lines extended to new factory district. Address city clerk.

Stanwood, Mich. — Stanwood will have an electric lighting system. Six men of the town have organized a company and will put up a plant adequate to the needs of the town. Wires will be installed all over the town, both for residence and store use. The company was organized by M. D. Crane, E. L. Smith and others.

Davenport, Iowa — Linograph Co. will erect the first unit of its factory building to cost about $100,000. The new building will be 65x150 feet, four stories and basement. It is the first of three units which will eventually be connected with a corridor.

Newton, Iowa—Plans are in progress for electric plant. Archer & Stevens, 609 New England building, Kansas City, Mo., architects. Additional lights will be installed. Address city clerk.

Fulton, Mo.—Board of Managers of Westminster College has had plans prepared for the construction of a new electric power and heating plant at the institution, estimated to cost $30,000. Contract for erection has been awarded to Oscar Thomas, Sedalia, Mo.

Kansas City, Mo.—The $500,000 bond issue for extensions at the municipal light plant was ratified at a recent election. Extensions which will almost double the capacity of the plant will be made within a few weeks. The estimated cost of the improvement will be $407,000.

Wichita, Kans.—Another unit is to be built to the Kansas Gas & Electric Co.'s plant at Third and Kelley streets at a cost of $500,000. Plans for the building have been prepared and the contract for its construction has been awarded for the Phoenix Utility Co.

Lincoln, Neb.—Secy. Danielson of the state fair branch has petitioned the council to extend the city lights to the state fair ground.

Omaha, Neb. — Nebraska Power Co. has filed a first mortgage for $5,600,000, the entire issue having been bought by the Guaranty Trust Company of New York. Part of the proceeds of the mortgage will be used to pay off $2,000,000 of bonds now outstanding and the balance will be used to make improvements.

Madison, S. D. — Bonds to the amount of $100,000 have been voted for an electric light plant.

SOUTH CENTRAL STATES.

Louisville, Ky.—Fifty houses at a cost of $200,000 will be constructed in Louisville by the Consolidated Realty Co. The houses will average between $4000 and $16,000 each. It is estimated that 2500 houses are needed in Louisville.

Louisville, Ky.—L. C. Lashment, secretary and treasurer of Wadell & Son, engineers of New York and Kansas City, has arrived in Louisville to begin construction on the new electric railway which will connect Frankfort and Shelbyville. The last connecting link has been surveyed and it is planned to begin construction so that the road will be in operation by Jan. 1, 1920. A plan to bridge the Kentucky river at Frankfort has been abandoned and the present plan is to use a bridge already in use over this stream.

Louisville, Ky.—O'Connor Realty Co. will erect two-story concrete garage, 60x244 ft., to cost $50,000.

Columbus, Miss.—The council after hearing and carefully considering a report on the condition of the water plant by an expert engineer decided to purchase two auxiliary electrically driven centrifugal pumps. It is estimated the new equipment will cost $7000. Address mayor.

Alexandria, La.—$40,000 in bonds has been voted to improve street railway. Address mayor.

New Orleans, La.—The Navy Department is arranging for the construction of a large new power plant at the local Government site. It is understood that the proposed plant with equipment will cost in excess of $250,000.

New Orleans, La.—Plans are under consideration by the Board of Managers of the Charity Hospital for the construction of a large new power plant at the institution, estimated to cost, with equipment installation, about $90,000.

Kingsport, Tenn.—Holston River Power Co., Johnson City, recently organized, plans the construction of hydroelectric power plants on the Holston river, near Kingsport, to cost about $3,000,000. The company proposes to furnish electric power for industrial operations and other service at Kingsport, Johnson City, Bristol and other points.

Petersburg, Tenn. — City council has arranged for the issuance of bonds for $15,000 to provide for the municipal lighting system. G. C. Hart is mayor.

Conway, Ark.—Plans are being prepared by the city for extensive improvements and extensions in the municipal electric light plant. Estimated cost $50,000.

Fort Smith, Ark.—The Commonwealth Public Service Corp., which purchases electricity from a local company to supply all towns between Van Buren and Clarksville with power and light and which also supplies several coal mines in Franklin and Johnson counties with power, will erect a large central power station in Johnson county, in the vicinity of Clarksville. The plant will cost approximately $200,000. Steam turbines will be used to generate the power.

Afton, Okla.—City council has approved the issuance of bonds for $10,000 to provide for improvements and extensions in the municipal lighting system.

Comanche, Okla.—City voted $35,000 bonds for electric and water plant improvements . Address the mayor.

Newkirk, Okla. — Bonds to the amount of $185,000 have been voted by the City Council, a portion of the proceeds to be used for extensions in the municipal lighting system.

Abilene, Tex. — American Public Service Corp. will construct units of electric light plant to cost about $350,000.

Ennis, Tex.—The city contemplates installing an electric light plant. Address mayor.

Houston, Tex.—Mack Oil & Water Well Screen Co., Kress building, proposes to build a new plant, consisting of three reinforced concrete buildings, 100x200 ft., 75x100 ft., and 30x50 ft., at an estimated cost of $200,000. Much of the equipment will be operated by individual electric motors. J. O. Mack, manager.

San Antonio, Tex.—The council is preparing to expend $25,000 for fire and police alarm system. Address Mayor Bell.

WESTERN STATES.

Havre, Mont.—The Montana Public Service Commission in an order recently issued authorized the Montana Power Co. to discontinue service and abandon operation of its heating plant at Havre.

Sildix, Mont.—Amazon-Dixie Mining Co. will install an electric power plant in the near future. The power line will in all probability be run from Mullan. The property is a silver-lead product and has been doing extensive development work for some time.

Salt Lake, Utah—Lafayette Hanchett, representating the Dixie Power & Light Co., accompanied by Manager Woodhouse of the company appeared before the state road commission to continue negotiations looking to construction of an electric power

line along the route of the Arrowhead trail, between St. George and Cedar City. The company seeks a way by which the state could undertake to construct the pole line and the company would furnish energy at the wholesale rate, to operate the mixers, rock crushers, pumping station, etc.

Mullan, Idaho—Amazon-Dixie Mining Co., at Sildix, Mont. about 11 miles from Mullan, Idaho, will install an electric power plant in the very near future. The power line will in all probability be run from Mullan.

Roseburg, Ore.—William Pellman, owner of the Roseburg light and water plant, is inspecting the properties with a view of making extensive improvements. The pumping and power plant will be improved and the entire system put in shape to accommodate Roseburg's increasing demands.

Kelso, Wash.—The contract for the new brick substation to be built in Kelso by the North Coast Power Co. has been let to N. A. Strand, Kelso, and construction work will be started immediately. The company is now rebuilding the line from Kelso to Kalama.

Tacoma, Wash.—The city will buy the Lake Cushman power site and build thereon a hydroelectric plant if the proposed bond issue of $300,000 is authorized at a special election to be held in July.

Glendale, Cal.—Bonds have been voted to improve water system, electric equipment will be purchased. Address city clerk.

PROPOSALS

Motor-Driven Ladder Truck.—Bids will be received until 10 a. m., July 11, by the Board of Public Works, Seattle, Wash., for one motor-driven 75-ft. automatic aerial ladder truck, two 100 and two 800-gal. capacity combination motor pumping engines and hose cars.

Lighting Fixtures.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until July 16 for installing lighting fixtures in the south building. Hygienic Service, United States Public Health Service, Washington.

Power Plant.—Bids will be received by the Water, Light, Power and Building Commission, Wells, Minn., until July 10 for the erection and completion of power plant building, concrete reservoir, and furnishing and delivering power plant equipment, in accordance with the plans and specifications of the Charles L. Pillsbury Co., engineers, 813 Metropolitan Life building, and Tyrie & Chapman, architects.

Electric Light System.—On July 11 bids for labor and materials required in the construction of an electric lighting system for the village of Church's Ferry, N. D., will be received, according to the plans and specifications which are on file in the office of H. A. Moe, village clerk, and also in the office of Earle D. Jackson, St. Paul, Minn. The work is divided into two parts, consisting of a brick and tile power house and furnishing and erecting two oil engines, necessary piping and accessories, two three-phase, 60-cycle, 2300-volt alternators with exciters, switchboard, etc., and furnishing and erecting poles for the electrical distribution in the village.

Electric Work.—Bids will be received by the supervising architect, Treasury Department, Washington, D. C., until 3 p. m., July 25, for furnishing materials for the construction of the United States Post Office, at Dawson, Ga., including materials for concrete, reinforced concrete, stone, granite, brick, structural terra cotta, structural steel, miscellaneous iron and steel work, composition roofing, slate roofing, sheet metal work, skylights, plastering, interior marble, sanitary slate, lumber, millwork, painting, glazing, hardware, plumbing, heating, electric work, etc., in accordance with drawings, specifications and bills of quantities attached thereto, copies of which may be obtained from the custodian of site at Dawson, Ga., or at the above office, in the discretion of the acting supervising architect. James A. Wetmore, supervising architect.

FOREIGN TRADE

[Addresses of firms referred to in these trade opportunities may be obtained by writing to the Bureau of Foreign and Domestic Commerce, Washington, D. C., or its branch and local co-operative offices. Request for each opportunity should be on a separate sheet and the file number

Electrical Supplies (29,748).—Drugs, chemicals and kindred lines; engineering and building materials, such as iron, steel, metals, heavy hardware, and machinery; electrical supplies for light, heat and power service, and for telephone and telegraph service, are required by a firm in Norway. Payments to be through New York and Norwegian banks. References.

Electrical Machinery (29,741).—The purchase of tubing for high pressure turbines and electrical machinery of all kinds for developing waterfall power is desired by a firm in a consular district of Spain. Quotations should be given f. o. b. New York. Terms, cash against documents. Correspondence may be in English. Reference.

Electric Power Plant (29,759).—The municipality of a city in Greece desires to receive proposals until Sept. 11, 1919, for the installation and operation under contract for a period of years, of an electric plant to furnish light and power to the city and its surroundings. Further information and terms of contract may be had on application to the Bureau or its district offices.

Motors, Dynamos, Electrical Apparatus (29,784).—An agency is desired by a manufacturer in Spain for the sale of cranes, elevating apparatus, gasoline, kerosene and crude-oil engines; mining machinery, machinery for the construction of public works; steam engines, electric motors, dynamos and electrical apparatus and supplies; complete material for aerial cableways; steel cables for traction and elevation; agricultural machinery and tractors. Correspondence should be in Spanish. References.

Electric Lighting Appliances (29,812).—The purchase and agency are required by a firm in Australia of all motor requisites, accessories, tires, cars, etc., novelties and specialty lines, electric lighting appliances for households, etc. Terms, cash against documents or 90 to 120 days after sight; also consigned stock to be paid as sold. Reference.

Electrical Goods (29,814).—A merchant from Peru who is in this country desires to be placed in communication with firms in view of securing agencies for the sale of electrical goods, agricultural machinery, hardware, etc. Reference.

Electrical Materials (29,815).—A wholesale dealer in Belgium desires to purchase and secure agencies for the sale of electrical materials of good quality. Correspondence may be in English. Reference.

Metal Filament Lamps and Insulated Cables (29,823).—The exclusive agency from manufacturers for the sale in India, Burma, and Ceylon, of electric metal filament lamps, ordinary and half watt, and electric insulated cables, is desired by a company in India. Reference.

Ice-making Machinery (29,809).—Ice-making machinery to be driven by oil engines or electric motors of 220-volt alternating current, suitable for manufacturing three tons of ice per 24 hours, is desired by a man in Costa Rica. Quotations should be given c. i. f. destination. Correspondence should be in Spanish. Payment, cash against documents.

Electric Vacuum Sweepers (29,810).—The purchase of electric vacuum sweepers is desired by a firm in Canada. Quotations should be given f. o. b. place of shipment. Terms, cash payment. To be shipped all rail. References.

INCORPORATIONS

Brooklyn, N. Y.—William C. Chapman & Co. Capital, $5,000. To manufacture electrical specialties. Incorporators: J. D. Murphy, W. C. and A. A. Chapman, 166 Brooklyn avenue.

Orange, N. J.—Wethling-Bakely Co. Capital, $100,000. To manufacture electrical appliances, etc. Incorporators: Edward Bakely, Livingston; and H. D. Wethling and A. D. Seymour, Orange.

Dover, Del.—Saw Tooth Power Co. Capital, $300,000. To operate a plant for the generation and distribution of electric energy. Incorporators: P. B. Drew, H. E. Knox and S. E. Dill, Wilmington.

Personal

Elliott Reid Made Sales Manager—C. McKew Parr Back from National Service — George Lockwood Passes Away

BENJAMIN C. PAGE has been appointed to the position of superintendent of the Sheffield plant of Fairbanks, Morse & Co., Three Rivers, Mich.

ALFRED M. BARRETT, Flushing, Brooklyn, N. Y., has been appointed Deputy Public Service Commissioner by Lewis Nixon, Public Service Commissioner, New York.

F. F. WINFREE has been appointed manager of the Sandpoint, Idaho, division of Mountain States Power Co. Mr. Winfree was formerly connected with the Richmond (Cal.) division of Western States Gas & Electric Co.

J. H. MORGAN, who recently resigned as manager of the local telephone exchange, has become associated with the Western Electric Co. installing farm lighting plants, with headquarters at Bentonville, Ark.

ELLIOTT REID, assistant to general manager of the Westinghouse Lamp Co., New York, has been promoted to the position of sales manager, effective July 1. In his new capacity Mr. Reid will be responsible for the commercial activities of the company in both large and miniature classes of lamps in domestic territory.

CLIFFORD M. HOLLAND, divisional engineer of the Public Service Commission, New York, has been appointed chief engineer to superintend the construction of the New York-New Jersey vehicular tunnel, estimated to cost about $12,000,000, by the New York State Bridge & Tunnel Commission, with headquarters at 115 Broadway.

C. MCKEW PARR, general sales manager for the Hart & Hegeman Manufacturing Co., Hartford, Conn., has rejoined the company after a year and a half in the national service. He was connected with the bureau of exports of the War Trade Board at Washington, and later was appointed a special representative of the Board with a commission as special assistant of the Department of State. He was also appointed vice consul at Las Palmas, Canary Islands, and at Barcelona, Spain, having also had missions in France and England.

LEONARD F. FULLER, chief electrical engineer of the Federal Telegraph Co., has resigned to become assistant manager of the Ohio Insulator Co., with headquarters at Barberton, Ohio. Mr. Fuller has been associated with the Federal Telegraph Co. during the period in which the Poulsen arc has taken a leading place in long-range radio communication, and much of the improvement in recent years contributing to their success is attributed to him. Mr. Fuller recently received the degree of Ph. D. from the Stanford University for his work in magnetic circuits in arc generators.

L. W. SCHNITZER, of the Ingersoll-Rand Co., is now manager of the pneumatic tool department of the company at Chicago.

H. W. STEELE, for five years superintendent of the gas and electric departments, El Reno division of Oklahoma Gas & Electric Co., has been appointed general manager of the gas and electric departments at Muskogee. Earl James of the Oklahoma City division of the company will succeed Mr. Steele at El Reno.

W. A. PIXLEY, general auditor of the Nebraska Telephone Co. and of the other companies of the Bell group having their headquarters in Omaha, Neb., has resigned and will devote his entire time to the Truck and Tractor Corporation of Omaha, of which company he is vice-president and general manager. Mr. Pixley has been with the Nebraska Telephone Co. for 27 years, during 14 years of which he has been auditor. Mr. Pixley has taken financial interests in the Truck & Tractor Corp. of Omaha. He is succeeded by F. L. Devereux of New York, formerly auditor of the long lines department of the American Telephone & Telegraph Co.

MAJ. J. B. JACKSON, after two years in the national service, has returned to his former position with the Commonwealth Edison Co., Chicago. While in France Major Jackson was in charge of the electrical design and construction throughout the S. O. S. territory, with headquarters in Tours. His work in this connection corresponded very closely with that of the Construction Division of the Army in this country, although he was confronted with many difficulties in securing the necessary material and apparatus which were not encountered in the work at home. He was formerly an illuminating engineer of the company and assisted in designing the lighting for the Edison building at 72 West Adams street, Chicago.

GEORGE ELLERY HALE, director of the Mount Wilson Observatory and foreign secretary of the National Academy of Sciences, who has been for the last ten years a Correspondent of the Academie des Sciences, Institut de France, has received the unusual honor of election as Associe Etranger, succeeding Adolph von Baeyer. The foreign associates are limited to twelve, and the high distinction has been held by only two Americans—Simon Newcomb and Alexander Agassiz. The National Research Council upon the presentation and acceptance of Dr. Hale's resignation as its chairman and the election of James R. Angell as his successor, created and bestowed in perpetuity upon Dr. Hale the title of honorary chairman in recognition of his services to the National Research Council and to science and research by indefatigable efforts that have contributed so largely to the organization of science for the assistance of the Government during the war, and the augmentation of the resources of the United States through the newly intensive cultivation of research in the reconstruction and peace periods that follow.

Obituary.

GEORGE LOCKWOOD, of Providence, R. I., one of the general managers of the National Lamp Works of General Electric Co., died suddenly in the hospital on Association Island on June 26, following an operation for appendicitis. He was born in Newark, N. J., and was a graduate of the Stephens Polytechnic Institute at Hoboken, N. J. Through his connection with Stephens Institute he became associated with John W. Howell, chief engineer of the Edison Lamp Works of General Electric Co., about 1890. For about four years he devoted himself to the manufacturing end of the lamp business, but subsequently engaged in the commercial end of the business in which he continued until the year 1898, and at that time he was employed by F. S. Terry to operate the factory of the Sunbeam Incandescent Lamp Co. at Des Plaines, Ill. In 1901 the Sunbeam Co., assisted by B. G. Tremaine, inaugurated the first activity which resulted in the formation of the National Electric Lamp Association, which subsequently was incorporated as the National Electric Lamp Co. and finally merged with the General Electric Co. Throughout the entire period of development Mr. Lockwood was active in creating and developing several branches of the National Electric Lamp Co. into sound business divisions, applying himself both to manufacturing and commercial problems. At the time of his death he was general manager of the Bryan-Marsh Division, National Lamp Works of General Electric Co., this division being one of the most important branches of the National Lamp Works.

The loss of Mr. Lockwood will be most keenly felt by the National Lamp Works, not only because of his ability to operate and manage a large and important branch of its business, but because of the great love and esteem for him held by every member of the organization. He leaves one sister, Mrs Alice Lockwood Olmstead of Des Moines, Iowa. He also leaves an uncle and aunt residing in New York City. The body will be taken to Newark, N. J., for interment. Mr. Lockwood was well known throughout the country and was connected with many of the electric and electric light organizations throughout the United States. "He was one of the strongest and best liked men in the electric light industry in the entire country," said Judge J. M. Woodward, of Cleveland, Ohio, attorney for the Electric Lamp Industry of the General Electric Co.

For the Readjustment Period—What?

XLIII.

The electrical industry, which played such an important part in the construction and equipment of ships for war service, has a large stake in the peace program outlined by Mr. Piez. It ought to line up solidly back of the project and make its influence felt in no uncertain way.

C. A. TUPPER *President*
INTERNATIONAL TRADE PRESS, INC., CHICAGO

Keep Up Ship-Building

Charles Piez, late director of the Emergency Fleet Corporation, believes that the vast effort and stupendous sums put into the business of ship building should and can be saved. He believes the investment can be made to pay splendid returns if proper steps are taken.

Out of the total of 181 yards entrusted with carrying out the fleet corporation's program, only sixty-one were in existence when we entered the war with Germany, and of these a material proportion were new and still without management. There were approximately only 50,000 experienced ship builders in the United States at that time, while on January 31, 1919, there were 301,627 employes engaged in the various ship yards constructing for the Emergency Fleet Corporation. As of April 30, 1919, there were delivered by the Emergency Fleet Corporation 766 vessels aggregating 4,427,551 tons. There were 499 vessels of 2,312,974 tons in the wet basin being fitted out and there were on the ways 633 ships of 3,411,390 deadweight tons. Of the total program then in hand there were 538 vessels of 3,801,591 deadweight tons, for which keels had not yet been laid but for which the steel and machinery had to a very considerable extent been fabricated.

In view of these facts, it is not to be wondered that suggestions to allow all this effort and money to go for naught should find Piez strongly in opposition. To him it is unthinkable that the splendid ship building facilities of this country should not be kept alive by temporary government support, when if moderate assistance is granted, they will soon be able to support themselves. To quote Mr. Piez:

"It has cost the nation at least $300,000,000 to teach 300,000 men and 120 new managements how to build ships, and with even temporary financial aid, American shippers can be taught to operate profitably even the very large fleet which we will have on our hands. At any rate, if we haven't the capacity and initiative to become a large shipping nation, let us at least remain a large ship building nation, now that our tuition has been paid for."

A. CLEMENT WILD
CHICAGO

Financial News

American Goods and Foreign Markets.

Figures setting forth the foreign trade of the United States for the month of April indicate nothing which is more striking than the continued dependence of the rest of the world, and particularly of Europe, on the products of the United States, both raw materials and foodstuffs and manufactured articles. The great increase in the value of exports over last year's figures (the totals are $714,513,000 for April, 1919, as against $500,422,000 for April, 1918), means, of course, that shipping is now available for carrying the goods to their destinations. During the same period imports have decreased, not only relatively but absolutely. Europe has not yet reconstituted her industry to the point where a definite reduction can be made in the preponderance in favor of the United States, and there are no indications that a balance will be struck in the very near future. However abnormal may be the present sale abroad of the goods of the United States, it is an abnormality which will probably continue for some little time; and readjustment, when it does come, will not restore pre-war conditions. The economic changes which the war has brought about will not be obliterated by a resumption of full-scale production by the industries of Europe. A large American export trade is a definite and continuing factor in the world's affairs.

There are several developments which may come out of the present situation, all of which are being set forth in current discussions by those interested in preserving the welfare of American industry and its attendant foreign trade. It is now generally accepted that the investment of American capital abroad is a necessary concomitant of the present state of the world's finances, and indeed this movement is already under way. The immediate advantages of such a course are the temporary restoration of foreign buying ability, the stabilization of exchange, and the assistance American capital will be in the reconstitution of Europe's disrupted productive forces, and in the building up of new industries in other parts of the world.

Foreign investments may take the form of long term credits, bonds having a fixed maturity, or permanent investments in stocks of corporations. All three would promote the sale of American goods in the countries to which the loans were made, and the first two at least would mean ultimately the payment to their holders here of money received from the sale in this market of foreign-made goods. In the third case, that of permanent investment in foreign stocks, the dividend payments would come to us indirectly in the form of goods. Foreign investment means, then, the stimulation of imports from the countries where the investments are made. It is quite possible, that, with the great payments already due us, and the increasing flow of goods resulting from our investments, the imports of the United States would ultimately be greater than the exports, unless a tariff barrier were placed to make it better, from a financial point of view, to reinvest the earnings of our investments in the countrfes of their origin, rather than to accept payment in goods. Barring such a possibility, the preponderance of imports over exports could not but be regarded as an evidence of strength, rather than weakness. It would mean that this country had achieved the position occupied by Great Britain before the war. Ships from all parts of the globe carried goods to the British Isles, returning with products whose value totaled far less. The difference, of course, was made up in dividend payments, and were the return on capital invested by the British over a long period of years. The same thing was true of France and several other countries wherein foreign investment was accepted as the financial policy of the people. In such cases it is necessary to distinguish between the so-called trade balance, and the actual financial balance, which includes not only goods, but all values.

Public Utility Credit Must Be Maintained.

The Illinois Committee on Public Utility information is quoted as follows:

"Because of the extraordinary capital demands of the industry and the heavy investment necessitated in every community obtaining electric, gas, telephone, water and street railway service it is clearly apparent that something must be done that will affect the credit of these companies. Unless the companies are treated fairly by the communities they serve they cannot go into the money market and obtain the funds necessary to keep pace with normal development and render the efficient service which every citizen has a right to expect.

"No industry makes as great a permanent investment toward the upbuilding of the community as the public utility industry. A rightly financed, properly managed and fairly regulated public utility company is as stable and enduring as anything that can be found in the business world.

"Supplying daily necessities more and more in public demand, growing as communities and industries grow, necessarily equipped with a large amount of valuable, tangible property, staked, tied to and embodied in the soil, these companies are urban and interurban fixtures. They have no years or seasons of shutdown due to poor business such as manufacturing enterprises must anticipate for they must furnish continuous and unending service."

Wisconsin-Minnesota Power Bonds.

The Wisconsin-Minnesota Light & Power Co. has sold an additional block of $650,000 of its first and refunding 5% bonds, due May 1, 1944, to the Harris Trust & Savings Bank, Chicago. The bonds are being offered at 87 and interest, yielding 6%.

Public Service Properties.

The 1919 edition of "Public Service Properties," comprising 61 pages, is being distributed by W. S. Barstow & Co., Inc., New York City. This book presents in convenient form general data regarding public utility companies with yearly gross earnings of approximately $9,400,000, after inter-company eliminations, and is based upon official statements and statistics. All the companies mentioned in the publication are under the regulation of state public service commissions. Accompanying the data on each utility is a map showing the territory served.

Dividends.

Sullivan Machinery Co. has declared a quarterly dividend of 1½%, also an extra dividend of 1%, payable July 15 to stock of record July 1.

Puget Sound Traction, Light & Power Co. has declared the regular quarterly dividend of 75 cents a share on preferred stock, payable July 15 to stock of record June 26.

Monongahelia Valley Traction Co. has declared a quarterly dividend of 37½ cents a share on its new preferred stock, payable July 7 to stock of record July 3.

Chicago Pneumatic Tool Co. has declared a quarterly dividend of 1½%, payable July 25 to stockholders of record July 15.

Central Illinois Public Service Co. has declared a quarterly dividend of 1½%, payable July 15 to stock of record June 30.

A quarterly dividend of $2 a share has been declared by the Commonwealth Edison Co., payable Aug. 1 to stock of record July 15.

WEEKLY COMPARISON OF CLOSING-BID PRICES OF SECURITIES OF LEADING ELECTRICAL COMPANIES.

Quotations furnished by F. M. Zeller & Co., Rookery Bldg., Chicago.

Public Utilities.	Div. rate. Per cent.	Bid June 24.	Bid. July 1.
Adirondack Electric Power of Glens Falls, common	6	15	14
Adirondack Electric Power of Glens Falls, preferred	6	76	74
American Gas & Electric of New York, common	10+extra	170	130
American Gas & Electric of New York, preferred	6	41½	41½
American Light & Traction of New York, Common	..	266	263
American Light & Traction of New York, preferred	6	99	98½
American Power & Light of New York, common	4	72	73
American Power & Light of New York, preferred	6	72	75
American Public Utilities of Grand Rapids, common	..	10	10
American Public Utilities of Grand Rapids, preferred	7	38	38
American Telephone & Telegraph of New York	..	107½	104½
American Water Works & Elec. of New York, common	..	5½	5
American Water Works & Elec. of New York, particip	7	12	11
American Water Works & Elec. of New York, first preferred	..	60	59
Appalachian Power, common	..	5	6
Appalachian Power, preferred	7	15	16
Cities Service of New York, common	+extra	375	376
Cities Service of New York, preferred	6	79¼	78⅞
Commonwealth Edison of Chicago	8	112	111
Comm. Power, Railway & Light of Jackson, common	..	28	28
Comm. Power, Railway & Light of Jackson, preferred	6	64	63
Federal Light & Traction of New York, common	..	12	12
Federal Light & Traction of New York, preferred	..	48	47
Illinois Northern Utilities of Dixon	6	70	70
Middle West Utilities of Chicago, common	2+extra	36½	36½
Middle West Utilities of Chicago, preferred	6	60	62
Northern States Power of Chicago, common	..	70	72
Northern States Power of Chicago, preferred	ex.div.	90	88
Pacific Gas & Electric of San Francisco, common	..	65	64¾
Pacific Gas & Electric of San Francisco, preferred	6	88	88
Public Service of Northern Illinois, Chicago, common	7	90	89
Public Service of Northern Illinois, Chicago, preferred	6	93	92
Republic Railway & Light of Youngstown, common	4	17½	17½
Republic Railway & Light of Youngstown, preferred	6	58	58
Standard Gas & Electric of Chicago, common	..	32	32
Standard Gas & Electric of Chicago, preferred	6	46	45
Tennessee Railway, Light & Power of Chattanooga, common	..	6½	6
Tennessee Railway, Light & Power of Chattanooga, preferred	6	20	21
United Light & Railways of Grand Rapids, common	4	49	49
United Light & Railways of Grand Rapids, preferred	6	74	74
Western Power of San Francisco, common	..	22	22
Western Union Telegraph of New York	extra	91	88
Industries.			
Electric Storage of Philadelphia, common	4	86	89½
General Electric of Schenectady	8	162½	163
Westinghouse Electric & Mfg. of Pittsburgh, common	7	56½	56⅛
Westinghouse Electric & Mfg. of Pittsburgh, preferred	7	57	57